SCIENTIFIC AMERICAN

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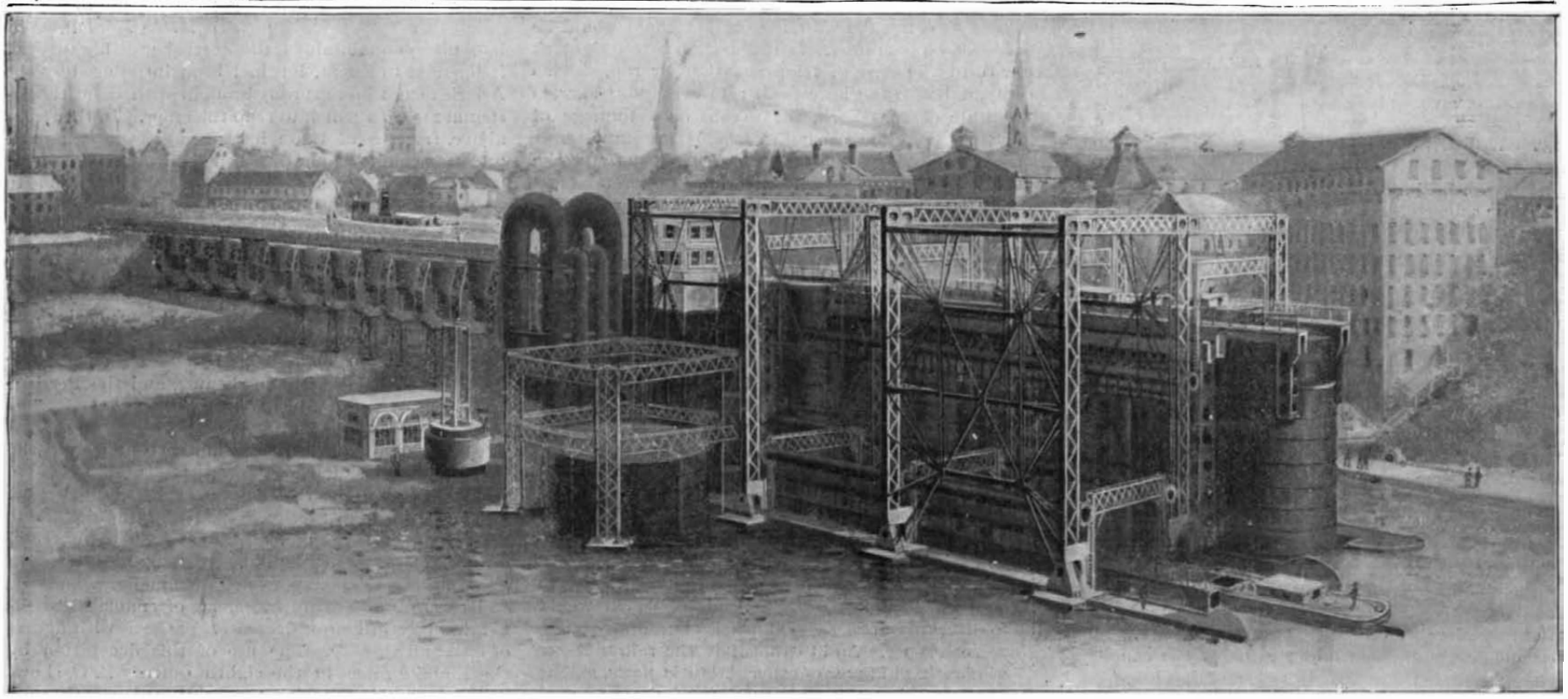
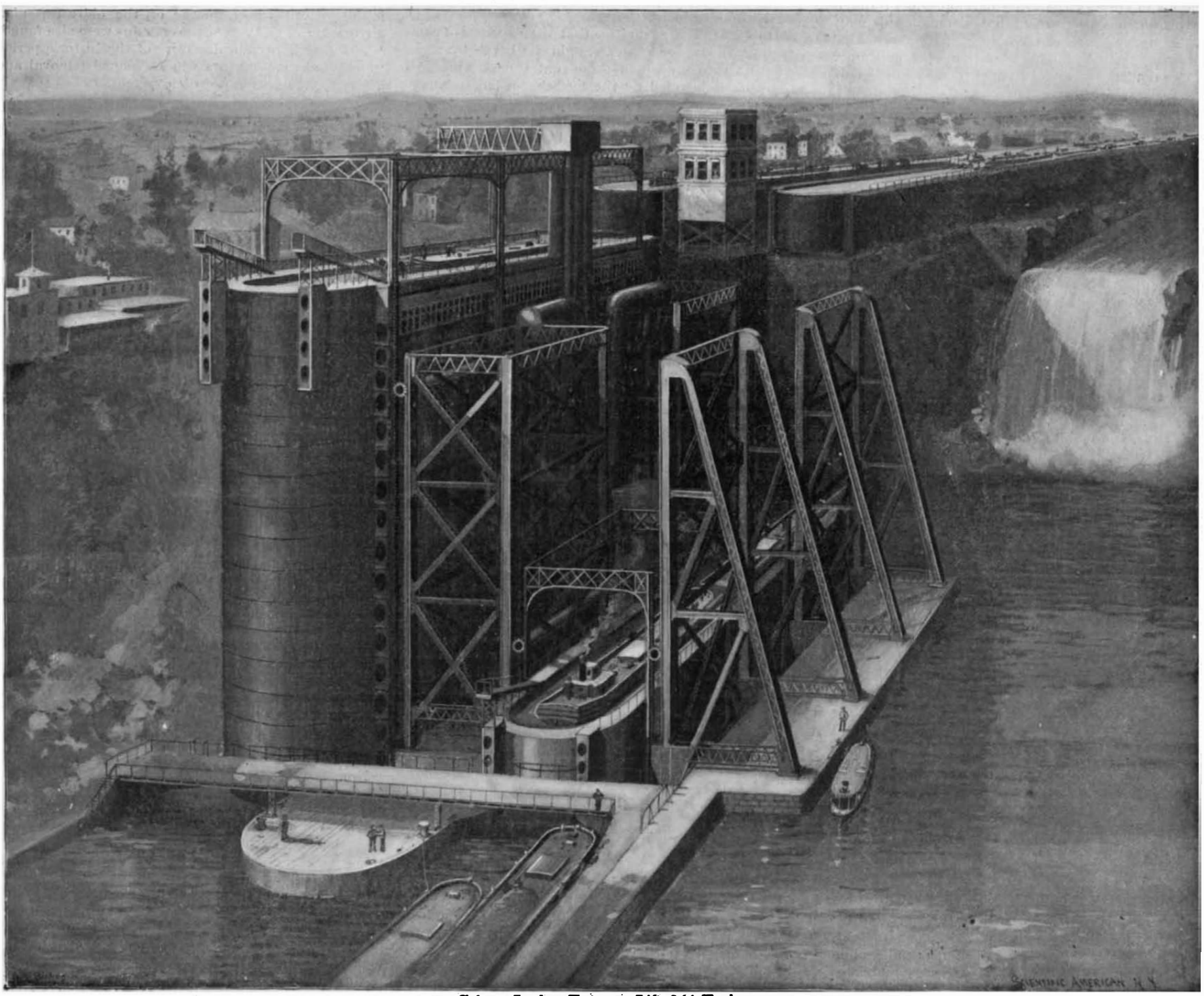
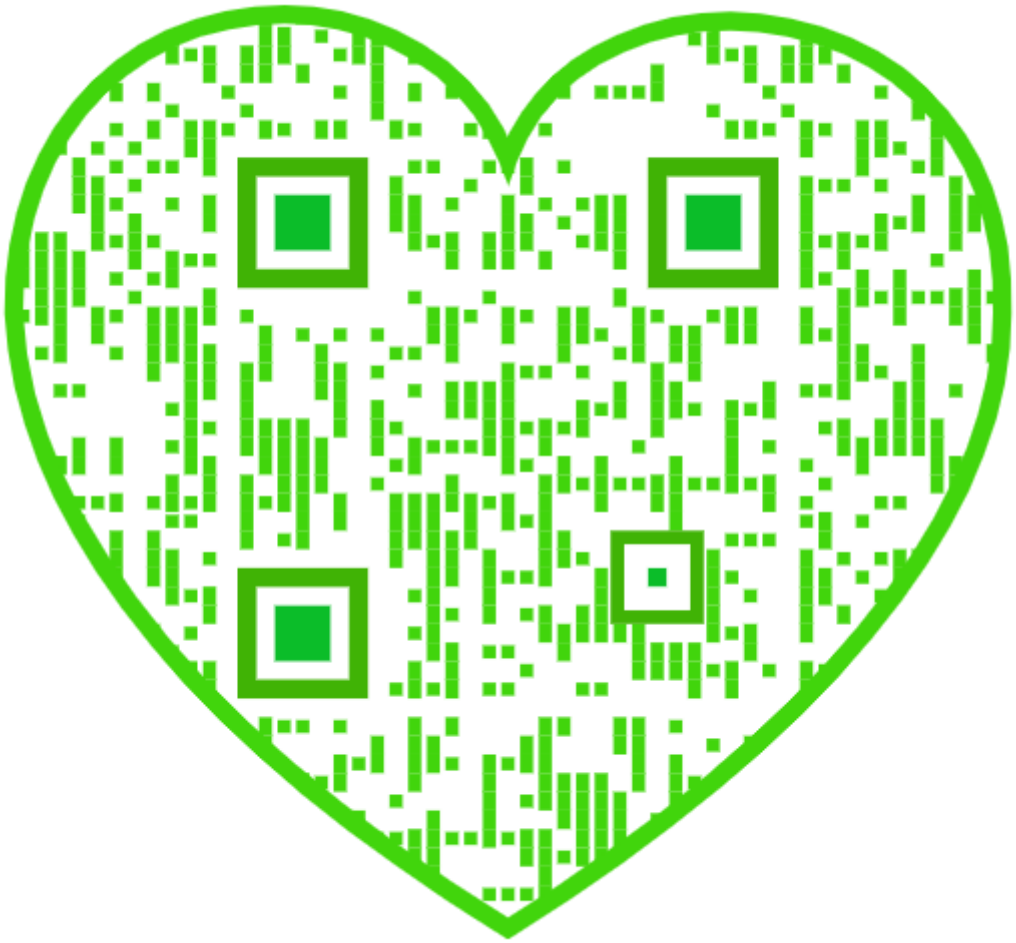


Lockport Locks—Extreme Lift, 62½ Feet.



Cohoes Locks—Extreme Lift, 144 Feet.

PROPOSED IMPROVEMENT OF THE ERIE CANAL—THE PNEUMATIC BALANCE LOCK SYSTEM.—[See page 74.]



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NEW YORK, SATURDAY, FEBRUARY 3, 1900.

THE ERIE CANAL PROBLEM.

In the course of a masterly review of the report of the Special Committee on Canals, Governor Roosevelt strongly indorses the recommendation of the committee that the Erie Canal be enlarged to accommodate boats of 1,000 tons burden, and that the improvement be pushed to completion at a cost of $62,000,000. The text of the report has reached us too late for insertion in the present issue; but we hope to publish a full digest with maps and illustrations in next week's issue of the SUPPLEMENT.

The first question to be considered by the committee was, necessarily, whether the canal should be kept or abandoned — whether the financial condition of existing canals elsewhere warranted any further effort to operate the Erie Canal either in its present condition or after the proper enlargements had been made. This question is answered strongly in the affirmative in the report of Mr. F. S. Witherbee, who, after a personal investigation of the European systems, finds that there has been a steady development in the number and size, equipment and receipts of the canal systems in the great industrial centers, and that it has been found desirable to maintain the development of the canals in spite of the rapid development of the railroads. It has been urged that although this may be true under European conditions, the remarkable economy realized in the operation of American railroads renders successful competition by canals impossible. To this the committee reply that although this may be true of a canal of small capacity like the present Erie Canal, or the improved canal contemplated by the scheme of 1895, the conditions would be so far reversed, if the canal were enlarged to accommodate boats of 1,000 tons burden, that freight could be transported from Buffalo to New York for about *one-third of the cost of rail.*

Having decided that the canals ought not to be abandoned, three alternative plans presented themselves for consideration: 1. To complete them on the lines proposed in 1895. 2. To make them ship canals capable of accommodating ocean-going vessels. 3. To adopt an intermediate course.

1. SCHEME OF 1895. — The plan of 1895, familiarly known as the Aldrich plan, provided for deepening the canal from 7 feet to 9 feet, enlarging the locks to accommodate boats of 450 tons burden; providing a single pneumatic or other mechanical lift at Cohoes and Lockport, as illustrated on the first page of this issue, and making changes at important points in the location of the canal. The estimated cost of this project is $21,161,645. The commission is of the opinion that this plan "is at best a temporary makeshift," and that were it carried out, it is certain that the benefits resulting would not justify the heavy outlay.

2. SHIP CANALS.—The committee considers that a ship canal is "a proper subject for consideration by the Federal Government, but not by the State of New York." They have seen various statements placing its cost at from $125,000,000 to three times that sum, and none of these estimates is based on data sufficiently accurate to justify careful examination. The object of a ship canal is to enable a ship to load at Chicago and not uncover its hatches until it reaches London or Liverpool. To do this the vessel must be built to withstand Atlantic storms, and such a vessel costs $71 per ton of its carrying capacity; vessels of the lighter construction suitable to the lakes cost about $36 per ton; while a canal fleet of the kind proposed by the committee, with a combined cargo capacity of 3,900 tons, would cost only $7.31 per ton. Hence the committee very justly conclude that the economics of the situation call for the three existing types of vessel (ocean, lake and canal) with a change of cargo at Buffalo and New York; or the use of 1,000-ton canal boats going direct from lake ports to New York and there transferring their cargo to ocean steamers.

3. THE SCHEME PROPOSED. — There remains the third course, which is to determine upon the size of boat which will give the best economic results, and enlarge the canal and the locks to accommodate it. After a careful consideration of the question in all its bearings, the Committee recommend practically the construction of a new canal from Lake Erie to the Hudson River, following the present canal for about two-thirds of the distance and new routes for the remaining distance, and utilizing as far as possible the existing structures and canals. The proposed canal, compared with the present canal, will be 12 feet deep, 75 feet wide at the bottom and 122 feet wide at the surface, as against a depth of 9 feet, a bottom width of 49 feet and a surface width of 73 feet. It will accommodate boats 150 feet in length, 25 feet in width and 10 feet in draught, capable of carrying 1,000 tons of freight. Such a canal would have a capacity of 20,000,000 tons per annum, and on that tonnage the saving as compared with the present canal would be $12,200,000 per annum. It could transport freight at one-third the cost of transportation by rail, and as compared with the lowest rail rate ever quoted across the State of New York, the saving on a tonnage of 20,000,000 would be nearly $18,000,000 per annum.

Since the completion of this project will call for the expenditure of over $60,000,000, the question arises as to whether the benefits to be gained are commensurate with such a heavy outlay. The answer is that they are not only commensurate, but greatly in excess of the cost; for the issue at stake is not merely the commercial prosperity of the State at large and the Port of New York in particular, but it is a question as to whether the great and enormously valuable wheat-carrying trade of the West shall be retained in the United States or drift over the border into the hands of the Canadians. The last link in the chain of improvements by locks and canals of the St. Lawrence River has just been completed, with the result that vessels 255 feet long, of 12 to 14 feet draught and 2,200 tons capacity, can now pass from the lakes to Montreal. Chicago and Buffalo capitalists have made a proposition to the harbor commissioners of Montreal involving the immediate construction of fifteen 2,200-ton barges, besides grain elevators and wharf facilities at Montreal to cost $4,000,000, the result of which would be to divert about 35,000,000 bushels of grain from the New York route. Add to this that the railroads are discriminating in favor of other Atlantic ports, and it can be seen that the construction of the proposed canal is of vital importance to the future development of the Empire State.

It seems to the committee that the expenses of completing the water routes should be borne by those counties through which these routes pass, a proposition that is justified by the fact that a large proportion of the traffic of the old canals was strictly local. The necessary $62,000,000 would be raised by an issue of bonds, the interest and sinking fund to redeem which would amount to only 10 cents per $100 of the assessed valuation of the counties through which the canal would pass. Of this sum, two-thirds would be borne by New York city alone; and in view of the fact that she is about to spend nearly this amount to secure improved transportation facilities, there is no question that the great metropolis will gladly perform her share in an undertaking which is so necessary to protect the threatened commercial interests of the State.

EXCAVATIONS AT SUSA.

Half a century ago Mr. Kennet Loftus directed attention to the archæological importance of the explorations on the site of ancient Susa. At that time nothing was known of the ancient and powerful Elamite kingdom of which Susa formed the capital. The position of the two great tumuli which marked the site of the ancient Elamite capital showed that the points were of great strategetic value. The larger of the tumuli is about 5,000 feet long and 3,000 feet wide. It marks the site of the Achæmenian capital, and at its northern extremity M. Dieulafoy uncovered palaces of Artaxerxes, Mnemon and Darius during his explorations in 1884–86.

On his resignation of his position as Director of the Gizeh Museum, M. de Morgan, the well known Egyptian explorer, was intrusted, says The London Times, with a special scientific mission to make a thorough exploration of the site. The first results were made known in his report to the Minister of Public Instruction and very fully justified the expectations that were formed. No explorers in Mesopotamia have produced such astonishing results or opened so many new problems. As Loftus and Dieulafoy have been unable to find any extensive pre-Achæmenian remains in the larger tumulus, work was commenced in a smaller but loftier mound some 800 feet to the west. It rises to the height of about 100 feet above the surrounding plains and gave every indication of being a more ancient work. On his arrival at Susa, in December, 1897, M. de Morgan prepared for a thoroughly scientific exploration of the site, and here his previous training as a geologist stood him in good stead. A skilled explorer knows that in all ancient sites, specially in the East, the law of stratification holds good, and that to ascertain the various strata and their ages is the first task before more minute examination can be made.

He first pierced the slope of the mound with five tunnels until the first historic stratum was reached at a distance of about 24 feet below the upper surface of the mound. It was in the lower tunnels that most important discoveries were made in finding no less than three strata of prehistoric times, the pottery affording as usual the most important data. The first stratum, which was about 40 feet above the plain, showed traces of civilized people. The pottery was remarkable for the fineness of its glaze and was decorated with patterns in red, black, and brown. These patterns were chiefly geometrical. In the next stratum, 46 feet above the base, the pottery was not so fine, being mostly vases of rough earth, but the flints became more numerous. Some of them were the flint teeth of sickles.

The discovery greatly pleased M. de Morgan, as he had always maintained that cereal growing was not indigenous to Egypt, but had been introduced by the Asiatic race, who naturally brought with them the instruments with which to reap the crops. In the strata above, remains of these instruments were still more numerous, and the teeth were polished and worn from usage. Stone maces began to appear, and rising to another stratum 68 feet above the base line, were first found burnt bricks and traces of buildings, but no inscriptions, and 13 feet higher the first town was discovered, the remains of the most ancient Susa. Above this, some 14 or 15 feet, we come upon the ancient Elamite citadel, which was destroyed by Assurbanipal about 640 B. C. Having ascertained the order of strata, M. de Morgan intrusted the work of opening the trenches to one of his assistants, and the Persian, Arabian and Greco Persian levels were reached. The things found may be said to cover a period of about five centuries from the Macedonian conquest to the rise of the Sassanian dynasty; that is, B. C. 330 to A.D. 226. Below this the Elamite stratum was reached.

The terrible destruction by fire and the deliberate razing of the walls made it impossible to ascertain accurately the general plan, but many discoveries of great archæological importance were made. Along the walls were found many fragments of enameled bricks bearing inscriptions or decorative patterns with figures of men and animals. The use of this decoration by the Elamite rulers in the eighth century B. C. shows us the source from which the Achæmenian artists derived their inspiration, and there are many other indications of this influence of the older Susanian civilization. The bases of the columns were also found.

The most important discovery of the historic period were certain monuments which escaped removal and destruction on account of their weight. The explorers unearthed a large stele of yellow limestone covered by an elaborately sculptured picture. It compares favorably with the sculptures of the Assyrians and is the record of an important campaign. The inscription upon it reveals the astonishing fact that it is a monument erected by Naram-Sin to commemorate his great campaign some time about B. C. 3750. M. Maspero and Dr. Schiel consider that it was carried away from Chaldea by the Elamites, but considering its great size and weight this hardly seems possible. The more probable solution is that the stele had been set up by the Chaldean king in Susa or in that region. There was also found a great obelisk of granite 6 feet in height, the sides of which were covered with a long inscription of some 1,200 lines written in very archaic characters.

The discoveries at Susa are most important, and the archæological world will look with interest at the photographs when they are sent home.

AUTOMATIC MACHINERY AND THE RUSSIAN PEASANT.

An incident has recently come under our notice which suggests that while our industrial success results largely from the invention of automatic machinery, it is also due to the readiness with which the American workman appreciates its value and the alacrity with which he makes haste to furnish himself with the very latest labor-saving improvements. We all remember how, during the great strike in the English engineering trades, it transpired that one of the chief grievances of the men was the introduction of automatic tools into the machine shops—the Trades Unions claiming the right to regulate the amount of output from each machine. That opposition, of course, was based upon the exploded theory that labor-saving machinery was inimical to the interests of labor. The prejudice was not against the machine, but against its supposed economic results.

Now, however, it appears that in some districts in Europe there is a positive prejudice against automatic mechanical devices as such, the laborer preferring to work by hand. The Russian peasant favors such automatic machinery as comes nearest to the hand operations to which he has been accustomed from time immemorial, and, as a matter of choice, in many cases, he will perform laborious operations on the machine rather than accept one which ignores hand labor altogether. A correspondent informs us that so pronounced is this prejudice, that he is designing an automatic harvester which will conform to the time-honored habits of the people with as little sacrifice as possible of its automatic features.

STONEHENGE.

The announcement that the famous and mysterious circles of stones on Salisbury Plain, England, known as "Stonehenge," have been offered for sale gave a new impulse to the interest which these remains of an earlier time have always excited. It was feared at first that the property would be purchased and, perhaps, carried away and erected on alien soil. The price named for Stonehenge and for about 1,300 acres of land adjoining was $625,000, and up to the present time no purchaser has been found, but it is hoped that the British government will see their way clear to buy this remarkable archæological monument, or at least some patriotic purchaser will buy it and guard it as it deserves.

The English Illustrated Magazine recently had an illustrated article dealing with the subject with photographs taken from new points of view, and from this we glean our facts. Like all standing stones, Stonehenge is, of course, a mystery, and all solutions of this eternal riddle must at best be guesses. The name is a corruption of the Saxon Stan-hengist, the uplifted or hanging stones; and this has, no doubt, given rise to the legend of enlargement and alteration by the British King Ambrosius, aided by Merlin, during the period of Hengist. Although absolute truth is impossible, the views of antiquaries concerning the origin of Stonehenge are worth considering. Some attribute the circles to the Phœnicians, or at least to Phœnician influence, and connect them with Baal-worship; others favor the familiar theory of Celtic or Druidical origin. The remains have also been ascribed to the Danes and Romans. The opinions as to its age are legion, some holding that the circles must have been formed in the century before the Christian era, others placing them as late as 500 A.D. The old puzzle as to the mechanical power employed is here, of course, particularly insistent on account of the ponderous cross-pieces of the trilithons. It is safe to conclude that the stones of the inner circle and inner oval have been brought from a distance, and are of earlier origin than the others. Among more recent theories as to the origin of Stonehenge is that of Sir John Lubbock, who inclines to the opinion that the circles were erected during the bronze age in Britain. It is, however, not improbable that various portions of the monument should be assigned to various dates.

The main features of Stonehenge are a "Via Sacra," or "Holy Way," two concentric circles of upright stones, two elliptical groups of stones, known as the great and little, a circular embankment, and at a considerable distance from these an isolated monolith, upon which tradition has bestowed the familiar name of the "Friar's Heel." The "Via Sacra" is an avenue 1,782 feet long and has the appearance merely of a long earthen embankment of inconsiderable elevation. At one time it was at least 15 feet high, and was defended by an intrenchment. The entire circuit of this mound measures 1,009 feet. Proceeding inward from the circular mound for a distance of 120 feet, the visitor reaches the outer circle of the group. This at one time consisted of thirty upright stones, 3½ feet apart, rising to the height of 16 feet, coupled by horizontal imposts so as to form trilithons. A rude mortise and tenon arrangement held them together. Of this circle there remain now only sixteen uprights and six cross-pieces. Nine feet within the outer circle are the remains of the sacred ring, containing now only seven upright monoliths. Within the second circle again is the remnant of what had been the most magnificent portion of Stonehenge, the first ellipse. Of these original five or seven trilithons there remain only two and two single uprights; these, however, reaching at their utmost the height of 21 feet, and nowhere less than 16 feet—16 feet also being the length of the imposts. These are sufficient to show the ancient grandeur of the first ellipse. The second was originally composed of nineteen uprights, of which only six remain. Within these is the so-called altar-stone, a flat rock 15 feet long. The Friar's Heel stands isolated at a distance of 120 feet from the circular embankment, and 240 feet from the innermost stone circle, the embankment being thus exactly midway between the Friar's Heel and the first circle. It is a huge irregular block 16 feet high, and is in a leaning position. Those who favor the Phœnician theory find in this monolith an astronomical significance and regard it as the gnomon or pointer of the rising of the summer sun. Whatever may have been its uses, Stonehenge remains for us a most fascinating riddle.

THE "GREEN RAY" AT SUNSET.

The "green ray" or "green flash" at the moment the sun disappears from view beneath the horizon has been noticed by many physicists. Some of them consider this is an optical illusion. M. Guebhard states, however, that the green ray is the great shadow of the earth feebly illuminated from the zenith and viewed by an eye fatigued for red; it therefore appears green. Pellat on the contrary states that the "yellow setting sun has a red lower and green upper border separately examinable in the telescope and due to prismatic reflection by the atmosphere. The absorption which makes the sun disk appear yellow makes the violet upper rim appear green or greenish blue instead of violet. When the sun sets, the upper green rim can be seen for a fraction of a second, but it may be kept longer in view if the observer goes up a slope as the sun sets." The first writer to which we have referred thought this was different from the green ray following the setting of the red sun. M. Raveau said that he had seen the sea colored green in a triangle with its apex at the point where the sun set, and the color seems to flow away toward the horizon.

THE NEW MINING DISTRICT AT CAPE NOME.

BY ENOS BROWN.

The latest vessel to leave Cape Nome, Alaska, arrived in port a few days ago bearing the last of the discoverers and a million dollars in gold dust.

Cape Nome has absorbed the attention of all those whose confidence in the future of Alaska as the greatest gold-producing country in the world has not been impaired by a want of success in the inhospitable interior regions of which Dawson is the great center. The American miners, driven out of the territories controlled by the Canadians, have been industriously prospecting along the coast, finding traces of gold almost everywhere. Rumors of the rich discoveries at Cape Nome have been abroad for over a year past, contradicted at times by those interested in keeping the knowledge of the real facts from the rest of the world. From private sources and from the occasional visits of the adventurous, information of the remarkable richness of the country has been disseminated in the West until the tide of travel and investigation turned toward the point and invaded the camp by thousands. In August, the population of Nome City amounted to 7,000 men, and in the country round about to at least 3,000 more. A city has grown up in a month, and though a very large proportion of the prospectors have left the country at the approach of the inclement season, at least 2,000 will brave the rigors of the climate and remain until the advent of summer permits a resumption of work.

The output of the Cape Nome mining region for the past summer amounts to $2,500,000, all from placers and with the aid of the most unscientific appliances. All of the peninsula on Norton Sound, from Norton Bay to Cape Prince of Wales, appears to be gold bearing. Within an area fifty miles east and west of Nome, fronting on the sea, gold-bearing sands have been discovered. Back toward the range which separates Norton from Kotzebue Sound, many gulches have been prospected and the most hopeful indications discovered. Where these gulches have been mined, in the immediate vicinity of Nome, the yield of gold has been astonishing. Taking into consideration the extent of country and its known richness, together with the comparatively easy methods required for extraction of the gold, it is the opinion of men, not the most enthusiastic, that in 1900 Cape Nome will produce more gold than all the rest of Alaska, Klondike included, put together. The new fields have the immense advantage of easy accessibility. From western ports to the beach at Cape Nome means only a comfortable voyage by steam or sail. There are no dangerous passes to cross or expensive outfits to purchase. It is on American soil and open to the miners of the world. Under these conditions it is anticipated that the summer of 1900 will witness the most gigantic flight of myriads of people that the world has ever known toward these new mines.

Cape Nome is situated in about the 64th degree of latitude, 120 miles north of St. Michaels and about 3 degrees south of the Arctic circle. The seasons are much milder than in the interior, and the more hardy vegetables can be grown there. Snow and ice disappear about the middle of May, and until the early part of October the climate is comparatively mild. Four and one-half months of work a season is the average. Ice begins to accumulate in the sea in October, and piles up in great hummocks during the winter season. The cold sometimes reaches 60 degrees below. In summer there is much rain and fog. The first placers were found on the beach in a strata of ruby sand, generally about three feet below the surface. The streak is about four inches in depth, and sometimes two or three are found, one above the other. On August 18, twenty-five hundred men were working on the beach and were averaging an ounce a day each. The theory has been that the gold thus mined is washed up by the sea. The origin is not as yet certainly known.

In the gulches the bed rock, as far as known, averages not deeper than five feet from the surface. Where worked, the yield of the gulches has been very large. Whatever the outcome of Cape Nome, it will ever be associated with the discovery of a new word in mining phraseology, "tundra," which is aborigine, and describes the low, marshy land lying between the beach and the foothills, having a width at Cape Nome of five miles and of indefinite length, a feature of all Alaska seacoast lands.

Travelers in Alaska all refer to the moss-covered soils saturated with moisture, abounding in great areas in the valleys and forests; a sort of spongy blanket on top of the ground, generally frozen underneath. At Cape Nome, extending from the sea beach back to the foothills, a distance of about five miles, and extending all along the shore, is a marshy stretch of land covered with moss. This is well defined and characteristic of the country, and is called by the Indians "tundra." Its depth at Cape Nome is three feet, and underneath, everywhere in fact, rich deposits of gold are found.

JOHN RUSKIN.

John Ruskin died at Brantwood, Conistan Water, England, on January 20. He was born in the heart of London, in 1819, his father being a wealthy wine merchant. He was writing for the press before he was sixteen, and he graduated from Oxford in 1842. He studied art for a year and then wrote a most remarkable book entitled "Modern Painters," which brought him fame and a storm of abuse. He soon became noted as a great master of words, and he began reeling off book after book on art and scientific subjects. He was Slade Professor of Fine Arts at Oxford for many years. He was one of the chief pioneers in the Pre-Raphaelite movement, and also paid great attention to economic and social problems. His "Stones of Venice" is probably his most widely read book.

In the death of John Ruskin the world has lost one of its greatest thinkers and one of the masters of English. His death had been expected for some time, and it is doubtful if it has created anything like the interest which it would have done some thirty years ago. He was one of those unfortunate writers who outlive their own reputation. He will never be forgotton, but his place in literature has been steadily declining for the last twenty years. His writings are injured by a bilious temperament, which resulted in outbursts of wrath upon the smallest occasion, and the views of Ruskin in most cases were diametrically opposed to modern progress; and while he storms at machinery, railways and steamboats and other things which enable us to carry on our existence in a comfortable and economical manner, his diatribes are always entertaining. His magnificent prose full of Oriental imagery is a lesson to all writers. The value of Ruskin's art writings is not very great at the present time, but he opened the eyes of a Philistine generation to the beauty of Art, and for this alone we should never cease to thank him. He told people what to see and how to see it. They saw with their own eyes, and abandoned his conclusions and deductions, which were usually based on wrong à priori premises. The result has been that as an advocate of art he is revered, but as a special pleader he is seen at his worst.

His ideas on art education are all wrong and his theories do not stand the test of logic. His views on geology, botany, social science and political economy, while pleasing and clothed superbly with an elegance such as these sciences had never before had, are still almost valueless. The artist repudiates his art system, the geologist his geological writings, and the political economist laughs at the absurd theories which would set us back three hundred years. One writer has said that "he literally got to the bottom of nothing;" with all his immense enthusiasm for science and art, he was superficial. His later life was saddened by a cerebral disorder the gradual increase of which strengthened the view which many held that his genius was closely akin to madness. He was not even consistent, for while he was spending thousands of pounds on the workingman and preaching from every lecture platform and urging men to read his gospel of life, he published his works in such a manner that they were very expensive, and his profits from this alone must have been enormous, sometimes over $15,000 a year, and still he wondered why people doubted his sincerity.

CROPS IN 1899.

The statistician of the Department of Agriculture has made public his estimates of the acreage production in value of the crops of 1899. The wheat acreage was 44,592,516, producing 547,303,846 bushels, having a value of $319,545,259, the average yield being 12·3 bushels, the average farm price per bushel being 58·4 cents. The corn acreage was 82,108,387, producing 2,078,143,933 bushels, the value being $692,210,110, the avarage yield per acre being 25·3 bushels, and the average price 30·3 cents. The acreage in oats was 26,341,380, the production was 786,177,713 bushels, and the value $198,167,975, the average yield per acre 30·2 bushels, and the average price 24·9 cents. The barley crop is estimated at 73,381,563 bushels; the rye crop at 123,961,741 bushels, the potato crop at 228,783,232 bushels, and the hay crop at 156,653,756 tons.

DEATH OF PROF. HUGHES.

Prof. David Edward Hughes, inventor of the Hughes printing telegraph instrument, which is now in use on all important continental lines in Europe, and all submarine lines between England and the Continent, died on January 23, in England, at the age of sixty-nine. He was the discoverer of the microphone now used almost everywhere as a transmitter for the telephone. He was also the inventor of the induction balance, a most interesting scientific instrument.

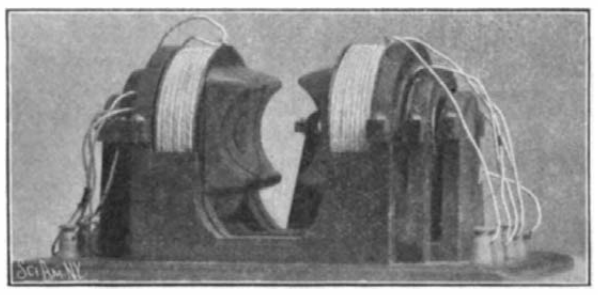
AN IMPROVED ELECTRO-MAGNETIC APPARATUS.

Our illustrations represent an efficient type of electro-magnetic machine, invented by Francisco de Borja Pavon, of Caibarien, Cuba, the field of which machine is so constructed that the lines of magnetic force are concentrated to obtain a current of great strength.

The two opposite fields consist of a number of tubular cores arranged one within the other, the innermost tubular core receiving a cylindrical core. The cores are surrounded by windings, so arranged as to prevent contact of their walls, and are independently supported by uprights and bases forming complete magnetic circuits. The upper portions of the uprights are made in the form of yokes screwed to the lower portion, so that the sections of the polar inductors may be readily removed and repaired.

The winding of the cores can be made continuous, because the current for all the coils is the same. But for the purpose of easily separating the parts, the inventor connects the ends of each winding with binding-posts on the base and thereby attains the same result as if he had used a continuous wire. To facilitate the interior magnetization of the tubular cores, each is longitudinally slotted, parallel to its axis.

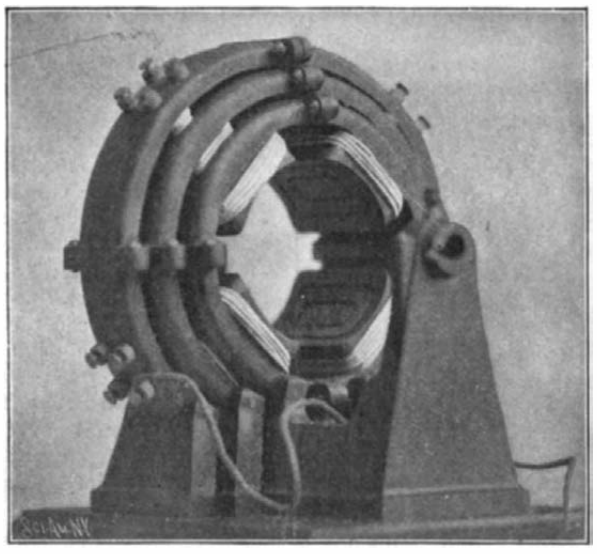
In this machine, the electro-magnets are excited by the same current, but each, with the uprights and



SINGLE CIRCUIT, BIPOLAR ELECTRO-MAGNETIC MACHINE.

bases, constitutes an independent system and magnetic circuit. But since the polar tubular ends are introduced one within the other, the magnetic force is concentrated toward the central core in the space between the opposite polar ends, thus producing an increase of the magnetic field as a result of the common action of the electro-magnets.

The principle can be applied to bipolar machines or



DOUBLE CIRCUIT, MULTIPOLAR ELECTRO-MAGNETIC MACHINE.

to multipolar machines with a double circuit, with tubular cores of circular, elliptical or square sections, and with armatures of any shape.

Influence of X-Rays on Selenium.

M. Perreau has lately made a number of researches as to the effect produced by X-rays upon selenium, and has presented his results to the Academie des Sciences. He finds that selenium, which is sensitive to light, is also affected by this form of radiation. The experiments were carried out with a selenium cell made up in the usual way with brass strips $\frac{1}{10}$ millimeter thick separated by strips of parchment paper of $\frac{4}{10}$ millimeter. The cell contained in a zinc box, and covered by a sheet of aluminium, was placed in circuit with a Daniell element, a resistance box and a galvanometer. The resistance of the selenium was found to be 40,000 ohms in the dark, and when exposed to diffused daylight or to a gas burner at a distance of 1½ meters, this fell rapidly to 33,000 ohms, coming back to its original value in the dark. When exposed to the radiation of a Crookes tube, whose anticathode was about 5 millimeters distant, the resistance of the selenium diminished rapidly to 34,000 ohms; upon suppressing the X-rays, the resistance returned to its original value, but somewhat more slowly than in the former case. The action diminishes as the tube is further removed, but is still appreciable at 17 centimeters.

STASSANO PROCESS.

BY FRANCIS P. MANN.

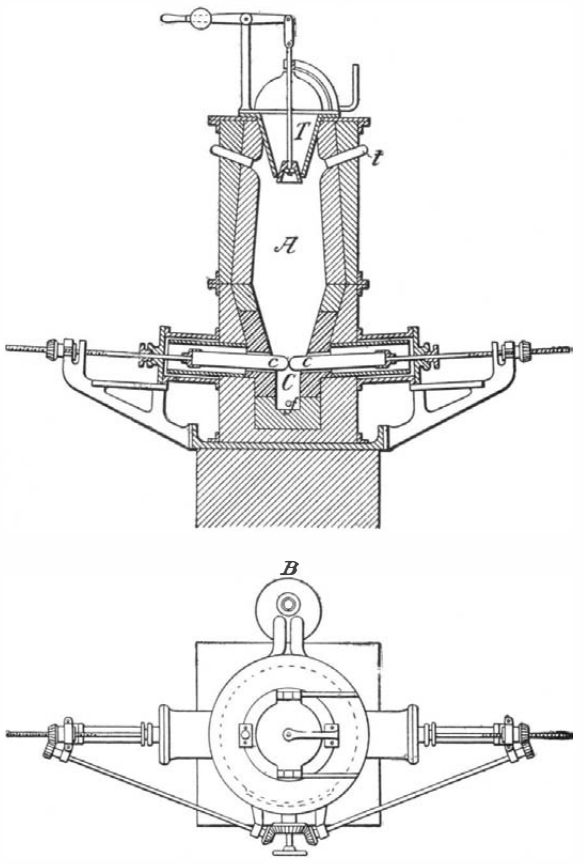
An interesting process has been lately devised by an Italian engineer, Stassano, for the production of iron and steel by the electric furnace, using the heat of the arc to reduce the oxides and fuse the resulting metallic mass. A series of tests has been recently carried on at Rome in which the process appears and has given satisfaction. The electric furnace used for this purpose has somewhat the appearance of a blast furnace on a reduced scale, and is formed of two truncated cones placed together at their larger base, as shown in the figure, in which *A* is the chamber where the ore is reduced and melted. The fused metal is collected in the crucible, *C*, below, and runs out by the opening, *F*. The two carbons, *cc*, are each 10 millimeters in diameter and are about one meter long; their distance is regulated by hand, according to the indications of the ammeter and voltmeter of the circuit. The slag is taken out by a hole in the top of the crucible, while the gases given off by the reactions rise through the mass and escape by the openings, *tt*. These openings may be closed by a hydraulic valve, *B*, to prevent the entrance of air when the mouth of the furnace is opened; the cover, *TT*, serves to close this, and is opened to introduce the charge.

In this process it is necessary to give the ores a previous treatment before introducing them into the furnace. These ores are generally oxides or carbonates; the latter are first roasted. A certain percentage of carbon, lime, or silica is added, analysis determining the proportion of each necessary for the reduction of the ore in question and to obtain a metal of a given composition. The ore and all materials are powdered and well mixed together, with the addition of 5 or 10 per cent of pitch which serves to agglomerate the mass. The resulting paste is formed into bricks by a hydraulic press, each brick containing about 0·04 cubic meter. After drying, these bricks are fed into the furnace. When it is desired to prepare an iron containing manganese, nickel, chromium, etc., the oxides of these metals are added to the powdered mixture. By the heat of the arc the ore is decomposed and forms in the presence of carbon carbonic acid gas, which is then transformed into carbon monoxide, and by the combustion of this latter gas the process is facilitated. The energy necessary for the production of a ton of metal is estimated at 3,000 horse power hours. The following table will show how this calculation is reached:

	Red Hematite, Fe_2O_3.	Magnetite, Fe_3O_4, or Roasted Carbonate.
Theoretical quantity of ore to produce one ton of metal	1,429 kilos.	1,380 kilos.
Theoretical quantity of combustible to produce one ton of metal	357 "	317 "
Heat necessary for the reduction of the metal	1,707 calories	1,600 calories
Heat necessary for the fusion of the metal	400 "	400 "
Heat developed by the transformation of C in CO	773 "	686 "
Heat necessary to be furnished to obtain the reactions	1,334 "	1,314 "
Electrical energy in horse power hours	2,100 h. p. hours	2,070 h. p. hours
Quantity of CO produced per ton of metal	750 kilos.	666 kilos.
Quantity of heat resulting from this	1,826 calories	1,622 calories

For the reduction of Fe_3O_4, for instance, will be necessary $\frac{1{,}380 \times 48}{232} = 285$ kilos. of carbon, or 317 kilogrammes of a 90 per cent combustible. If it is desired to produce steel, a somewhat larger percentage of carbon is necessary, but that contained in the pitch must be also taken into account. It will require, then, 1,600 calories to reduce the 1,000 kilos. of iron contained in the magnetic oxide, and 400 calories to melt the resulting mass, or a total of 2,000 calories; deducting 686 calories developed by the oxidation of the carbon, 1,314 remain to be furnished by the electric energy; this corresponds, allowing 75 per cent efficiency, to 2,760 horse power hours. The 3,000 previously estimated will thus cover the energy necessary for producing a ton of metal; this may be produced in Italy for about 18 lire, and in spite of the cost of preliminary operations, maintenance of the furnace, etc., the great economy realized on the fusion permits of arriving at a much lower price per ton of bar iron. According to the inventor, this does not exceed 100 lire, as compared with 160 lire by the usual process. A part of this economy is obtained by using the excess of carbon monoxide to heat the furnaces for the ingots.

The principal ores found in Italy are hematites, magnetites, and spherosiderites. Red hematite is found in considerable quantities in the island of Elba; magnetite in the valley of Aosto, in the district of Ivrea, and at Cape Calamite. Extensive deposits of spherosiderites exist in the valleys of Camonica and Trompio, where numerous hydraulic plants could be economically placed. An experimental furnace of 100 horse power has been established at Rome for the treatment of the Camonica ores; the energy is furnished by two dynamos of 300 horse power each, and the potential reduced by transformers to 50 or 60 volts. After passing the current for twenty minutes to heat the furnace, the charge was gradually introduced; the treatment lasted for thirty-five minutes. From time to time, the current varied on account of the differences of resistance encountered in the mass by the arc. A quantity of metal



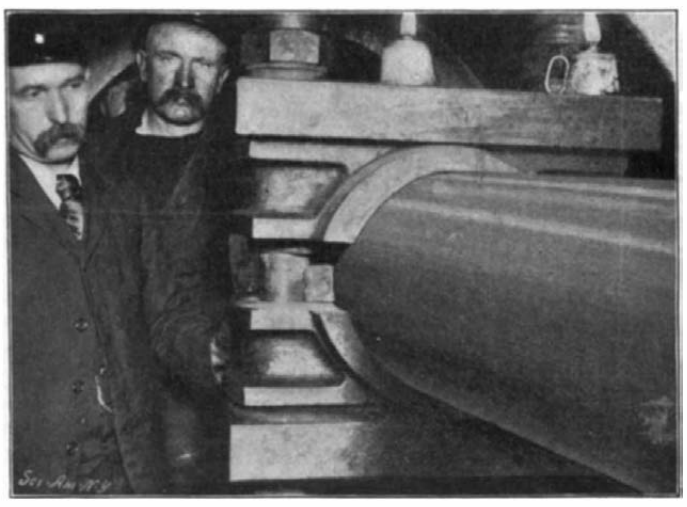
VERTICAL SECTION AND PLAN OF STASSANO ELECTRIC FURNACE.

equal to 8 kilogrammes was thus obtained, with an expenditure of energy of 2·7 horse power hours per kilogramme. The numerous tests carried out under these conditions have resulted in the formation of a company which will take up the process and in the near future will install three furnaces of 500 horse power each in the valley of Camonica, whose total yearly production is estimated at 4,000 tons.

REPAIRING A PROPELLER SHAFT AT SEA.

There recently came limping into the port of New York, with a broken propeller shaft, the tramp steamer "Manica." Her torn and battered topsides and deck fittings bore eloquent tribute to the fury of the Atlantic gale in which she all but foundered; while down in the engine room and in the shaft tunnel she bore evidence, in the shape of many an ingenious makeshift repair, to the resourceful skill and indomitable pluck with which the engine-room staff had confronted impending disaster and saved the ship.

The "Manica" is a freight steamer of 2,733 tons gross tonnage, and 11 knots' speed, belonging to the Norton line. Ordinarily she runs from New York to the River Plate. On the present occasion she was on a voyage from Shields, England, to New York, and when about



PROPELLER SHAFT REPAIRED AT SEA WITH TWO SPARE CRANK-PIN BRASSES, AND TWO CAPS AND HOLDING-DOWN BOLTS FROM THE MAIN ENGINE.

1,600 miles from her destination she experienced very heavy weather, in which she broke her propeller shaft cleanly in two. The fracture, which occurred on the second length of intermediate shafting from the thrust block, was what is known as a "scarf" break. It began about 4 inches from the coupling and extended diagonally for 34½ inches through the shaft The

wedging effect of the forward portion of the shaft, coupled to the engine, riding over the after length, smashed three of the "stools" or plummer blocks and their caps, lifting the shafting out of its bearings. The force of the waves, as the ship rose and fell in the trough of the sea, was sufficient to drive the propeller violently against the rudder post, leaving 10 inches of opening at the point of fracture. The first thing to be done was to uncouple the after portion of the shafting and draw the broken ends together with screw bolts. Two spare crank-pin brasses were then placed around the break, two of the main-bearing caps from the main engine were placed above and below the brasses, and two spare holding-down bolts of the main intermediate shaft. This was done by placing a series of large washers above the main brasses and trusting to the strength of the brasses to hold the crank shaft down in place. Steam was then turned on, and the vessel completed the remaining 1,600 miles of her voyage at a speed of 10 knots an hour, only two or three stops being necessary to tighten the bolts on the broken shaft.

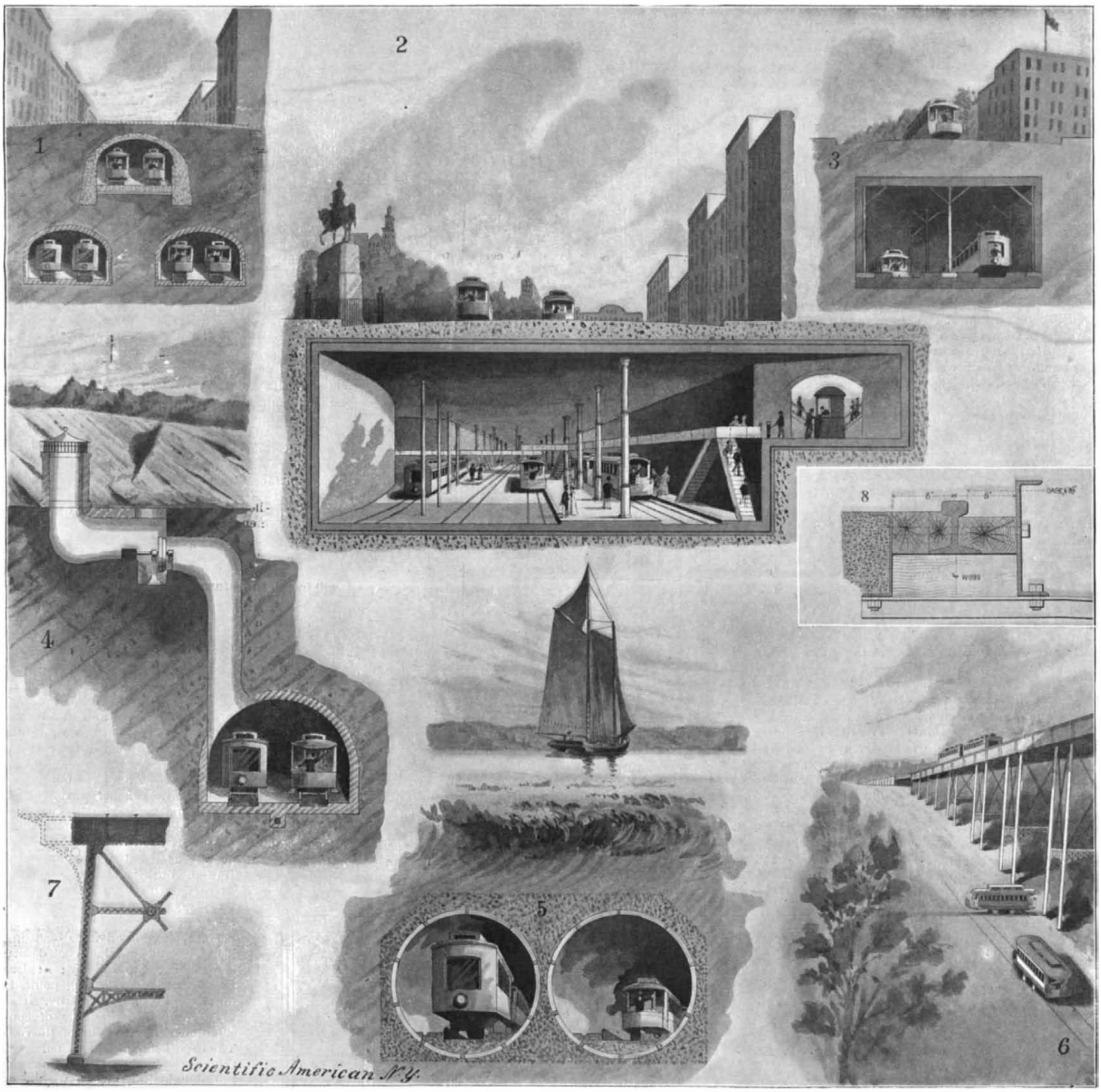
The repairs were made in terrific weather, while the ship was lying helpless in the trough of the sea and was being boarded by occasional seas which smashed the upper works and found their way into the hold and the cabins. When the vessel reached New York, it was noticed that the tremendous wedging strains at bearings were used to bolt the brasses and caps together, as shown in the accompanying illustration, which was taken in the shaft tunnel after the arrival of the "Manica" at New York.

So far, so good. There still remained the three broken caps of the shafting in the shaft tunnel. It was impossible to replace these, and all that could be done was to utilize some sling-chains from the deck, winding several coils around the shaft and fastening them to the tunnel floor. The after portion of the shafting was then drawn up to place and the coupling-bolts inserted. Before steam could be turned on it was necessary to make some provision for holding down the main bearings, whose caps, as we have shown before, had been used to splice the break in the the fracture caused the white metal of the brasses to squeeze out at the edges. The sling-chains, whose duty it was to hold down the shafting in its bearings, were also, of course, considerably worn, in spite of the fact that they were kept thoroughly lubricated. Great credit is due to Capt. C. G. Smith and Chief Engineer J. Gooding and his assistants for pulling their ship out of such an ugly and apparently hopeless predicament. We are indebted for our illustrations and particulars to Consulting Engineer A. McDermott, of New York, who had charge of the repairs.

AN order from France for fifty pressed steel cars has been received. If these cars prove successful, it is expected that much larger orders will follow.

THE NEW YORK RAPID TRANSIT TUNNEL.

Although the New York Rapid Transit Tunnel is such a really stupendous undertaking, far exceeding in magnitude any work of the kind elsewhere, the details of its construction and the manner of executing it are not so complicated but they may be easily understood by the average lay reader. The accompanying series of illustrations cover pretty well all the main features of the construction, the various views having been selected with the object of showing the general plan which will be followed throughout the major portion of the route and the various sections of the road where local conditions call for departure from the general plan.



1. The four-track road in two tunnels below the Park Avenue tunnel. 2. Fourteenth Street station, looking north. 3. Two-track line below Lenox Avenue. 4. Ventilating shaft for tunnel beneath Central Park. 5. Tubular tunnels beneath Harlem River. 6. Elevated portion at One Hundred and Twenty-fifth Street. 7. Details of viaduct construction. 8. Details of track.

THE NEW YORK RAPID TRANSIT TUNNEL.

The route of the road, as shown in the accompanying map, starts from a large underground loop which will be built beneath the City Hall Park. The four tracks within this loop will be carried in two stories, two tracks above and two below, but at the point of junction between the loop and the main four-track line, the tracks will converge to a common level, and will continue at the same level practically throughout the whole length of the system. The four-track road will pass beneath Center Street and Elm Street to Fourth Avenue, which it will reach in the neighborhood of Ninth Street. Thence it will continue beneath Fourth Avenue and Park Avenue until it swings to the left into Forty-second Street, beneath which it will run to Broadway. The four-track road will continue underneath Broad-

way and the Boulevard (now known as Broadway) until One Hundred and Fourth Street is reached, where the system will divide into two two-track lines. The western branch of the road, which will be known as the West Side Line, will continue along a route which is approximately parallel to the North River, passing through Spuyten Duyvil to the neighborhood of One Hundred and Thirtieth Street. The eastern branch, which will be known as the East Side Line, will swing to the northeast, passing beneath the northwest corner of Central Park, and running beneath Lenox Avenue to the Harlem River, under which it will be carried in two tubular tunnels. It will then continue in a general northeasterly direction to Bronx Park. The distance from City Hall Park to the northern terminus, both of the East and West Side lines, will be about 13½ miles.

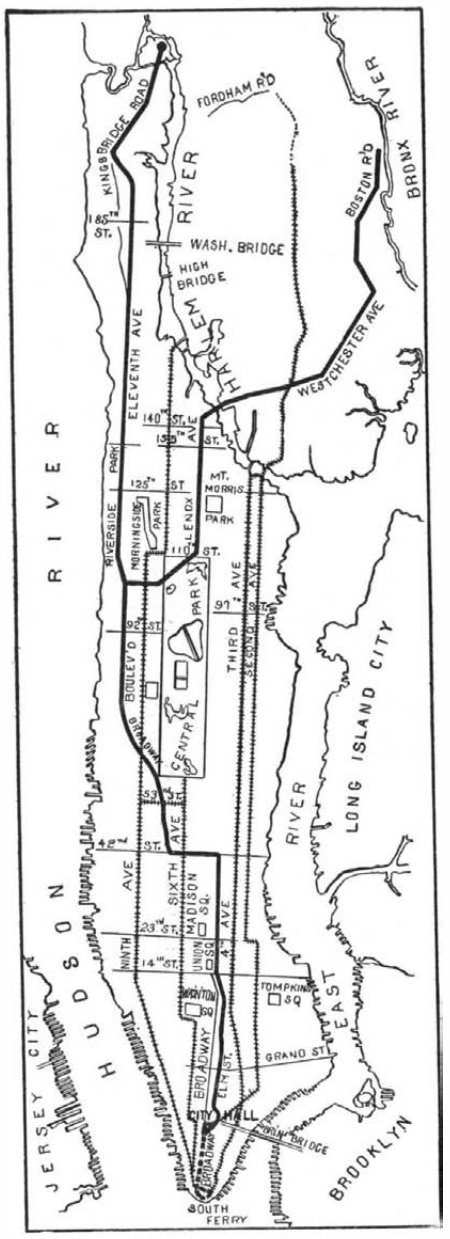
While the rapid transit system will essentially provide a through express service, it will, of course, run a certain number of local trains. The express trains will make but few stops, and the two inside tracks of the four-track road will be reserved exclusively for their use. There will be express stations at the most important centers only. The local trains will make use of the two outside tracks and will, of course, stop at every one of the forty-three stations between City Hall Park and east and west side terminals. The small number of stops and the considerable distance between stations will enable the express trains to maintain a high average of speed and will bring the total time of making the trip from City Hall Park to the Harlem within measurable distance of the "fifteen minutes" which has long been the dream of the New York traveling public.

With the exception of that portion of the road beneath the present Fourth Avenue tunnel of the Metropolitan Street Railway (Fig. 1), below Central Park (Fig. 4), and where the road passes beneath the Harlem River (Fig. 5), and the elevated portions of the lines (Fig. 6), the road will be carried in a steel and concrete conduit of absolutely waterproof construction, details of which are shown in Fig. 10. The floor of the conduit, or tunnel, consists of a foundation layer of concrete, which will vary in thickness from 8 inches upward, according to the conditions of the underlying material, being 8 inches on rock, with an increasing thickness on loose and damp material. Above the 8-inch layer will be spread a layer of waterproof material which will be put down as follows: After the 8 inches of concrete has been carefully smoothed off, a layer of hot asphalt will be spread upon it. Above this will be laid and rolled down a sheeting of felt. Then another layer of asphalt will be spread, the process being continued until the desired thickness of waterproofing has been put down, the layers of felt varying from two to six according to the moisture and general characteristics of the surrounding material. Above the waterproofing will be placed another layer of concrete, in which will be set the tracks and stone pedestals for the steel columns and I-beams supporting the roof and sides of the tunnel. The steel framework of the tunnel is made up of transverse bents consisting of built-up columns spaced 5 feet apart longitudinally, and 12 feet 6 inches apart laterally. Above each bent will be heavy I-beams, the wall columns consisting also of heavy I-beams. The space between the I-beams of both the wall and roof will be filled in with concrete, which will be smoothed off flush with the outer flanges of the metal work. Immediately upon the flanges and the outside surface of the concrete filling, as thus finished off, will be placed a complete layer of asphalt and felt waterproofing similar to that used in the floor, and described above. After the felt has been put in place, an outer layer of concrete, which will vary in thickness according to the nature of the excavation, will be carefully rammed in place. It will thus be seen that the whole concrete tunnel is inclosed by a waterproof envelope which extends entirely around it.

In Fig. 8 is shown the detail of the track construction, which is built into and forms an essential part of the concrete flooring of the tunnel. The 80-pound steel rail is carried on white oak wooden blocks, which are laid with the grain transverse to the rail. The rails with their bearing blocks are held in place by two deep channel-iron guard-rails which are bolted to metal cross ties embedded in the concrete. The inner channel is sufficiently deep to form an effective guard rail to keep the cars in line in case of derailment.

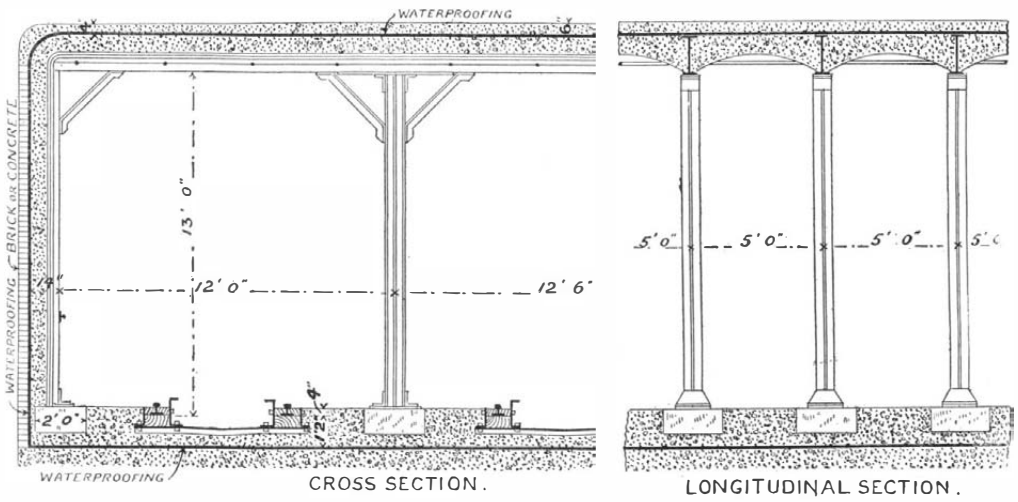
The double-track subway, as shown in Fig. 3, is in all essentials similar in construction to the four-track portion, and this drawing will apply equally to the west and east side lines.

As we have already stated, there are several points at which the standard construction of the tunnel, as already described, is replaced by tunnel construction of the ordinary type. The first of these will occur beneath Park Avenue (Fig. 1), where the four tracks will be placed in two tunnels below the level of the present Fourth Avenue tunnel. These tunnels will be excavated through the solid rock and will be lined with concrete or brick with a back filling of masonry or concrete. The next tunnel will occur where the east side line passes beneath Central Park, and as it



9.—MAP SHOWING, BY HEAVY LINE, ROUTE OF NEW YORK CITY RAPID TRANSIT ROAD.

will lie at a considerable depth below the surface, it will be necessary to install a system of artificial ventilation, as shown in Fig. 4, where a vertical shaft will lead from the tunnel to the surface. In the shaft will be installed a powerful, electrically-driven, ventilating fan. The next departure from standard construction will be at the Harlem River, where the track will be carried in two parallel single-track cast-iron tubes, each of which will be 16 feet in external diameter. As this



10.—CROSS SECTION AND LONGITUDINAL SECTION, SHOWING STEEL-AND-CONCRETE CONSTRUCTION.

part of the tunnel will pass through the soft material under the bed of the river, the tubes will be laid in a casing of concrete, as shown in the drawing. The roof of the tunnel will be approximately 21 feet below mean low water on the Harlem River.

Both the east side and the west side branches will contain a considerable amount of elevated structure. On the west side lines the tracks will leave the tunnel construction at One Hundred and Twenty-second Street and will be carried on a masonry and steel viaduct to near One Hundred and Thirty-fifth Street, over 2,000 feet of this distance consisting of a steel viaduct of the kind shown in Figs. 6 and 7. The approaches of the elevated structure will be of masonry, and the steel portion will consist of plate girder spans supported on plate cross girders carried on built-up columns which will be set on the curb lines.

As first constructed, the structure will provide for two tracks, but with wise forethought, the engineers have provided for an enlargement of the floor system by means of a bracket construction (see portion of drawing, Fig. 7, shown in dotted lines) which will enable an additional track to be placed on each side of the structure. This arrangement will render it possible in the future to double the capacity on both the east and west side branches when the necessities of traffic call for it.

We show in Fig. 3 a view of one of the most important stations on the line, namely, that at the intersection of Fourteenth Street and Fourth Avenue, which may be taken as typical of most of the stations of the system. Access to the station will be had by means of double stairways descending from the edge of the sidewalks, one on each side of Fourteenth Street, east of Fourth Avenue, and one on the south side, west of Fourth Avenue.

At the foot of the first flight of stairs from the street will be the ticket offices, from which the passengers will proceed by elevated crossings to the platforms, which will be four in number, the two outer platforms being for local traffic and the two inner ones for express trains. The interior of the stations will be lined with white enameled brick, and, as they will be brilliantly lighted with electricity, there will be none of the gloominess which is naturally associated with the idea of an underground station.

The cars will be commodious and well lighted, and will, indeed, embody all the latest improvements known to the electric car builder. It is probable that the third-rail system of electrical construction will be used, although, we believe, the details of the electric installation have not been thoroughly determined upon.

The plans for the road were drawn up by the chief engineer of the Rapid Transit Commission, Mr. William Barclay Parsons, and the contract, which has been let for a round sum of $35,000,000, has been undertaken by Mr. John B. McDonald, who expects to have it completed within three years' time.

Explosion of Chlorate of Potassium.

M. Berthellot, in a series of experiments recently made, has succeeded in bringing about the explosion of chlorate of potassium by operating in a special manner. This compound, although it enters into different explosive mixtures, has not hitherto been considered as an explosive body; when gradually heated, it decomposes into chloride of potassium and oxygen, which latter is given off with disengagement of heat. M. Berthellot finds that he can bring about a detonation under ordinary atmospheric pressure and in an open vessel; it is necessary to introduce it suddenly into a vessel which has been previously brought to a temperature higher than that necessary for the decomposition of the chlorate. The experimenter has already brought about in this way the detonation of picric acid, which burns, under ordinary circumstances, in the open air. He takes a glass tube, closed at one end, of 25 to 30 millimeters diameter; this is fixed vertically in a support and the closed end enveloped by the flame of a Bunsen burner, it being heated over a length of 50 to 60 millimeters until this part of the tube is visibly red. The chlorate of potassium has been prepared in advance by fusing it in a capsule and then cooled until it commences to solidify; a glass rod, drawn out to a long point, is dipped into this repeatedly, so as to accumulate a globule of considerable size at the end of the rod. The tube being kept at a red heat, the rod is introduced into it and the globule brought to within 10 millimeters of the bottom, care being taken not to touch the tube at any point. In a few moments the chlorate becomes liquefied under the influence of the heat and commences to drop upon the bottom of the tube; each drop makes an explosion, at the instant it touches the red-hot glass, with a very sharp noise and a white smoke formed of chloride of potassium. This explosion does not, however, affect that part of the globule remaining on the end of the rod. M. Berthellot considers that an explanation may thus be found for the explosions of chlorate of potassium which has been stored in large quantities in certain chemical works.

At the Pan-American Exposition at Buffalo, in 1901, the buildings will be lighted up by electricity generated by gas engines using natural gas.

Correspondence.

Roller Boats Again.

To the Editor of the SCIENTIFIC AMERICAN:

I have just seen a reference to the Knapp boat in your current issue which is very unfair. You say that the Knapp boat rolled 41 miles in five days.

The boat, having over one hundred tons displacement, was rolled over 50 miles down the lake with 5 horse power in 10 hours' actual steaming. Now, you know that it would be impossible to drive a boat of the present type of equal capacity at the same rate of speed with anything like that power. Then, again, the Knapp boat is not by any means at rest, but is now being remodeled to carry out Mr. Knapp's own design, which was departed from against his wish by the engineers responsible for the building of this boat. A demonstration will be made of the complete success of this type in the course of another two or three months.

SCOTT HUTCHINSON, B.Sc.

McGill University, January 8, 1900.

An Interesting Case of the Use of Insects as Food.

In a paper read before the Biological Society of Washington, and published in Science, New Series, Vol. IX., No. 216, pages 233–247, February 17, 1899, and reprinted in the SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 1209 and 1210, March 4 and 11, 1899, entitled "The Economic Status of Insects as a Class," the writer referred briefly to the use of insects as food, showing that they have formed articles of diet for certain savage peoples since the beginning of the human race. He called attention to the fact that Hope, in 1842, catalogued forty-six species of insects used as food, and that Wallace, in 1854, showed that insects of six different orders were used as food by the Indians of the Amazon. He called attention to the little book entitled "Why Not Eat Insects?" which, although published with an ostensibly serious intent, was, it must be feared, more or less a hoax.

Prof. Riley's experiments with the edibility of the Western grasshopper and of the so-called seventeen-year locust must not be forgotten in this connection, nor yet the experiments frequently made by schoolboys in the preparation of a fair article of lemonade by crushing the bodies of ants, diluting with water, and sweetening with sugar.

An interesting note, long overlooked, has just come to the writer's attention through a brief reference in The Agricultural Gazette, of New South Wales, for December, 1899. There is, in Australia, a cutworm which frequently does much damage to wheat crops, and the adult moth of which is known popularly as the "Bugong" moth, from the fact of its occurrence in great numbers in the Bugong Mountains. The natives of the Tumut district used to send to these mountains and collect the moths in thousands among the openings in the granite rocks.

In January and March of 1865, Mr. Robert Vyner visited the Bugong Mountains, accompanied by a "black fellow" known to the whites as "Old Wellington." The tops of the Bugong Mountains are composed of granite, and present a series of lofty peaks. Up one of these, a peak called by the natives "Numoiadongo," Mr. Vyner and his companion climbed, the path being so steep and rugged that even wild cattle never attempted it. The moths were found in great masses, sheltered between the rocks in deep fissures. On both sides of the chasms the face of the stone was literally covered with the insects, packed closely side by side and overlapping. Six bushels of living specimens could easily have been gathered, and so abundant were the remains of former moths that a stick was thrust into the débris to a depth of four feet. Old Wellington cooked about a quart of the moths for Mr. Vyner, who found them exceedingly nice and sweet, with a flavor of walnut. The "black fellows" collect the moths, according to Mr. Vyner, by spreading a blanket or sheet of bark beneath them. The moths, on being disturbed with a stick, fall down, and are gathered up before they have time to crawl or fly away, and are thrust into a bag. Then a hole is made in the sand and a fire made in it until the sand is thoroughly heated, when the coals are removed for fear of scorching the bodies of the insects (as, in such a case, a violent storm would arise, according to a superstition of the natives). The moths are now poured out of the bag, stirred about in the hot ashes for a short time, and placed upon a sheet of bark until cold. They are then sifted in a net to get rid of the heads, the wings and legs having previously been singed off. They are generally eaten in this condition, but sometimes they are ground into a paste and made into cakes. The species is said by Mr. W. W. Froggatt, the Government Entomologist of New South Wales, to be Agrotis infusa Boisduval, and the account of Mr. Vyner's observations is published in a paper by A. W. Scott, M.A., in the rare Transactions of the Entomological Society of New South Wales, Vol. II., for 1867–73.

L. O. HOWARD.

United States Department of Agriculture.

Science Notes.

We are in receipt of a publication devoted to the phonograph and projecting pictures, entitled Bulletin phonographique et cinematographie, which is published in Paris. It is a paper of considerable size.

Dr. Schenck has been dismissed from his professional positions by request of the Vienna medical faculty for the "frivolous publication of scientific matter." Of course this referred to Dr. Schenck's alleged discovery of a method of predetermining the sex of offspring.

In 1899, 107,415 cabin and 303,762 steerage passengers landed at the port of New York. The North German Lloyd brought 19,769 cabin passengers and 53,646 steerage passengers in twenty-nine trips, while the Cunard line brought 19,045 cabin passengers and 20,853 steerage passengers in sixty-two trips.

The olive crop of France, Italy and Spain is practically a failure. As compared with an average crop, it will hardly reach 30 per cent, in the opinion of well-informed judges. The Italian olives are the greatest sufferers from the pest to which existing conditions are due, southern France being also affected, and Spain in some localities. The damage is wrought by a fly which deposits its eggs in the green fruit.

The Italian government has recently become very strict in issuing passes for museums, etc., to students. Formerly it was not very difficult for foreigners to obtain free passes for the institutions which they were going to visit a great deal, if they were artists or students, but now they must present certificates from the director of some government art institution or some document which will show that they are entitled to the courtesy. As the admission fees are not large, rules of this kind should not be objected to.

Five hundred thousand young trees from 3 to 20 feet tall were chopped down to supply the Christmas trade of New York. These trees come from the Adirondacks, Maine, New Jersey and Connecticut. The amount of plants and flowers sold in New York is estimated to be in the millions, including half a million violets, 200,000 roses, 200,000 carnations, 100,000 lilies of the valley, 500,000 miscellaneous plants, 100,000 bunches of ferns, 4,000 cases of holly, 500 cases of mistletoe, 200 cases of princess pine, 500,000 yards of garlands and 750,000 wreaths.

At the Moscova, on the retreat from Moscow, the French lost 30,000 men; at the battle of Leipsic in 1813, the French losses were 65,000 in three days. At Austerlitz the French lost 28,850 men; at Plevna, 18,000 to 20,000 Russians were killed and wounded. At Gravelotte, the German loss was over 20,000, and the French loss 19,000. The aggregate of the losses at the battle of Stone River in the American civil war was 13,249 on the Federal side, and 10,266 on the Confederate side; at Gettysburg, a large number were killed and 14,497 wounded on the Federal side, while the Confederates lost 2,592 dead and 12,760 wounded. From this it will be seen that the casualties of the British army in South Africa are not excessive.

A radiometer for measuring the heat radiation of the stars has been tested at the Yerkes Observatory. The instrument is the outcome of the work of Mr. E. F. Nichols, of Dartmouth College. It consisted of a suspension system formed of two mica disks, each 2 mm. diameter, blackened on the face, and supported by a light cross arm on either side of a thin glass staff, hung by an exceedingly fine quartz fiber in a partial vacuum. Both vanes were exposed to the radiation of the sky at the focus of a silvered glass mirror of 24 inches aperture, fed with light by a siderostat outside. The rays entered the radiometer through a small window made of fluorite. With the apparatus so arranged, a deflection of 0·1 mm. would be given by a candle fifteen miles distant, neglecting loss by reflection and atmospheric absorption. The results obtained showed that stellar heat radiation was distinctly detectable.

We have received Part II. of the 19th Annual Report of the United States Geological Survey. It contains five papers, "Physiography of the Chattanooga District, in Tennessee, Georgia, and Alabama," by C. W. Hayes, which sets forth the results of a study of a region in which several distinct types of land surface are characteristically developed under such conditions that the part taken by the several factors can be fairly well determined. The second paper, "Principles and Conditions of the Movements of Ground Waters," by F. H. King, contends that the water which occupies the interior of the earth's crust is like that of the ocean and atmosphere, constantly in motion. These motions are at once numerous and extended and very complex, and are brought together and discussed under three categories: gravitational, thermal and capillary. The third paper, "Theoretical Investigation of the Motion of Ground Waters," by C. S. Slichter, relates to investigations of general problem of the flow of water through porous soils or rocks. The fourth paper is entitled "Geology of the Richmond Basin, Virginia," by N. S. Shaler and J. B. Woodworth. The final paper is "The Cretaceous Formation of the Black Hills as Indicated by the Fossil Plants," by L. F. Ward with the aid of collaborators.

Electrical Notes.

In the experiments which have been carried on in South Africa with the Marconi system in wireless telegraphy it was found that cannonading had no effect on the system.

Twenty sets of the Marconi apparatus will be installed on our warships. The first charge for each set will be $500, and an annual rental of $500 per set will be paid to the company.

An international street railway congress will be held at the Paris Exposition in September, 1900. The International Street Railway Association has selected Paris as its meeting place in 1900.

Signals have been sent by wireless telegraph through a suite of seven rooms, the doors of which were closed. They were transmitted through a telegraph switchboard containing both dead and live wires.

The use of electrical equipment at many army posts has resulted in the creation of a new grade of Electrician Sergeant to meet the demand of the service, and a school for their instruction is in existence at Fort Monroe, Va.

A submarine cable from Cape Town has been laid to St. Helena, and the cable was landed on November 23, 1899. The present tariff is $1.70 per word, but on the final completion of the line, the rate will be 97 cents to England.

The first Chinese electric railway has been opened, and connects the Pekin Railway station and the south gate of the capital. The Chinese have not any very serious objections to electricity, as it does not profane the air as does the locomotive, which irritates the spirits of the water and air.

A burglar has been caught in London, and according to the English Electrical Engineer, among his implements of trade was found a portable electric light set. It was undoubtedly intended to be used in his business, as it could be easily switched on and off, and there would be an entire absence of odor.

In the laundry of an insane asylum at Pontiac, Mich., electric irons instead of gas irons have proved to be peculiarly adapted for insane asylum service, where most of the work is done by the patients. There is no chance of their setting anything on fire with the irons, and as the irons are kept at an even temperature, they do not require the exercise of judgment in changing them.

Lieut.-Commander J. C. Colwell, United States naval attache in London, witnessed at Yeovil, on January 17, the test of an invention which has been offered to the government for steering torpedoes and submarine craft by means of a wireless electrical device on the lines of the Marconi system. The invention, however, is not in any way connected with Mr. Marconi. Lieut.-Commander Colwell was much pleased with the experiment, which demonstrated that the principles were correct.

The Marconi system will be used in the course of a few weeks on the mail steamers between Dover and Calais, and also on the mail steamers between Folkestone and Boulogne. The vessels when in mid-Channel or half an hour from either French or English shores, will have telegraphic communication with either side. No messages will be accepted from the public, and the system will be used only for the service. One pole erected at Dover will command both fleets, either in crossing the Channel, or in port on the other side of the water.

In the Cincinnati Zoological Garden, electricity is employed for guard duty. A fence of fine wire mesh about eight feet high surrounds an inclosure in which there are a number of fine game birds. It was found that rats, cats, etc., climbed over this so that two copper wires were stretched all around the top of the fence about an inch and a half above it and some distance apart. A switchboard was put on the side of an attendant's house and at dark the watchman turns on the electric current, which is supplied from the electric light wires. The silent watchman accomplishes remarkable results in killing the predatory animals.

A system of electric train lighting in use on the Paris, Lyons, and Mediterranean Railway has a dynamo provided on each carriage, arranged with its axis parallel to the rails, says The Engineer. A friction wheel on a prolongation of this axis is pressed against one side of a running wheel. In this way the motion of the wheel is transmitted to the dynamo. Between the dynamo and the axle which drives it a friction clutch is provided, consisting of carbon brake blocks pressing on a bronze disk. The pressure of these carbons on the disk is such that slipping only commences when a current of 28 amperes at about 16 volts is being generated by the dynamo. This corresponds to a speed of about 30 miles per hour. At any higher speed slipping occurs, the idea being that the speed of the dynamo shall not increase, as an increased speed would also correspond to an increased torque. The dynamo is used to charge a battery of accumulators, which supply light to the train when it is stationary or only going at a slow speed.

THE IBIS.

BY PROF. CHARLES F. HOLDER.

The spectacle of the ibis so thoroughly at home in a pool within the corporate limits of Los Angeles, Southern California, is suggestive of the mild winters of that region, as these birds, as a rule, are confined to the tropics or their immediate vicinity. The birds shown here were introduced some years ago, and soon became perfectly domesticated, living among the great clumps of tule, apparently perfectly contented.

This is the glossy ibis, found in tropical regions and in Mexico; and while it is an attractive and graceful creature, it has not the beauty of color possessed by the scarlet ibis of South America, which Audubon believed he saw in Louisiana, but which has never been observed there since. The glossy ibis is common in Mexico in summer, retreating to more congenial climes in winter; yet as suggested, the winters of Southern California apparently do not trouble the birds shown in the illustration.

The color of this species varies with age, this being so marked that different names have been given the different birds, as glossy ibis, green and gray ibis. There is no difference in plumage between male and female. The latter is a little smaller than the male. In the adult bird a dark chocolate hue pervades the neck, head, and part of the back, while the wing coverts are darker and dashed with green; the tail is glossed with purple and green. The beak is dark brown with a touch of purple, and around its base, including the eye, is a naked space that gives the impression of a face. This is colored a grayish green; the legs and feet are also of this color. The bird is about two feet in length, and its position in the water or as it stands among the tules is at once dignified and graceful, well shown in the accompanying illustration. The young lacks the glossy sheen which characterizes the adult, and is more mottled.

THE IBIS OF SOUTHERN CALIFORNIA.

The so-called sacred ibis, and the fact that it figures extensively in the literature and religion of the ancient Egyptians, has given the group more than ordinary interest. The sacred species is Ibis æthiopica, a striking bird, being pure white, the disconnected barbs of its plumes a purple black. The head and neck are naked, the latter being black. Travelers on the Nile always have the sacred ibis pointed out by those who "personally conduct," but the bird seen is the buff-backed ibis, the real sacred ibis having long ago disappeared from the Lower Nile, confined now to the region south of Khartoum. There is very good reason to believe that the sacred ibis never was found in Egypt or Nubia except in the case of a few individuals, the vast numbers in the tombs being explained on the theory that the Egyptians imported them.

The buff-backed species is very common, and was formerly, more than at present, employed as a scavenger, and protected in Alexandria. Dr. A. H. Adams writes: "Every street in Alexandria is full of them. In certain respects they are useful; in others troublesome. They are useful because they pick up all sorts of small animals and the offal thrown out of the butchers' and cooks' shops. They are troublesome because they devour everything; and dirty, and with difficulty prevented from polluting in every way what is clean, and what is not given to them." The birds apparently are protected, as are the buzzards in Charleston; those roosting about the market place do not add materially to the cheerfulness of the surroundings though they are of undoubted value, and in some towns evidently cheaper than a system of sewers. Thousands of mummified birds are found in Egypt and the bird frequently figures in the sculpturing of this country, and evidently for some reason made a strong impression upon the people. Hermopolis was the patron city of the ibis, and it was imported into Italy in early times and kept at the temples of Isis, the emblem of Thoth, the secretary of Osiris, and supposed to record the deeds of the dead, thus explaining the presence of its figure upon so many monuments.

To see the bird to-day it would be necessary to go far into tropical Africa. It nests near Khartoum in September, according to Dr. Vierthaler, forming the nests in the mimosa trees which are surrounded by marshes. As many as thirty nests, constructed of course with twigs and lined with feathers and fine twigs, have been counted in a single tree. Three, sometimes four greenish white eggs are laid, about the size of those of a duck. The birds from long exemption from interference pay little or no attention to the natives, moving about among them and near their flocks without fear; but they avoid the white man and lead him a long and generally fruitless chase.

A PORTABLE SEARCH-LIGHT FOR FIRE DEPARTMENT USE.

The search-light has been found of the greatest possible use in navigation, in warfare and for spectacular purposes. It has never before, we believe, until now been pressed into service as a means for saving life. Our engraving represents a new portable search-light which the New York Fire Department has had installed as a part of the equipment of Engine Company No. 20, on Marion Street, in the heart of the drygoods district. At first sight the apparatus resembles the ordinary fire engine, and, in fact, it was built by the La France Fire Engine Company, of Elmira, N. Y. It is intended for use at fires at night, or where the smoke is very dense, as the light penetrates the smoke easily and enables the firemen to save life and put out the flames much better than with lanterns.

NEW YORK'S LATEST FIRE FIGHTER—THE PORTABLE SEARCH-LIGHT PLANT AT WORK.

The boiler is of upright tubular pattern and drives a Forbes upright engine with 5×5 cylinders, which at a pressure of 100 pounds makes 600 revolutions per minute. There is an independent Blake duplex feed pump, and there is a 10-gallon feed tank. The engine is direct-connected to a Bullock ironclad multipolar marine type generator, and the current is furnished at a pressure of 80 volts, each light taking 35 amperes of current. There is a flywheel between the engine and the generator to assist in making the motion regular. There are two search-lights of the Rushmore marine pattern, of 6,000 candle power each, the barrels being 18 inches in diameter. They are carried on each side of the driver's seat. The usual means are provided for turning them at any angle, and special care is taken to provide means whereby the vibration is taken up. The search-lights can be removed from the pins which secure them at the front of the apparatus, and they may be placed on portable standards which are carried at the rear of

the boiler along with the cables. Two reels of double flexible conductor cables carry 200 feet of cable, and the connections are so arranged that there can be no confusion as to positive and negative. One of the search-lights is provided with lenses which throw a square beam of light on the face of the building, while the other is an ordinary reflecting search-light whose rays may be converged or diverged at will. The light is controlled by block switches and a rheostat, which is situated behind the driver's seat. Weston ammeters and voltmeters are provided in order to enable the electrician to obtain readings at all times when the current is being generated. There is little doubt that the machine will prove of great value in many cases where at present the facilities for lighting are very inadequate, such, for instance, as at fires on ships. The apparatus may be run out on a pier and one of the great lamps made to project the light into the hold, thus enabling the firemen to conduct their salvage operations with more immediate chance of success. In searching ruins for bodies the lamps will also prove of great use. Smaller incandescent lights will be carried in time for use in cellars, etc. The portable search-light plant has been a favorite subject of study with Fire Chief Croker, and the results of the new experiment will be looked for with interest.

NEW EXCAVATIONS AT CARTHAGE.

Since the month of January of last year, some important excavations have been made at Carthage, in ground never before explored. It was M. Gauckler, the learned director of the antiquities of Tunis, who, after obtaining the consent of the owners of the land, began the work according to a definite plan, before bringing to light a necropolis of the Punic epoch.

The site of the excavations is situated at the base of Bordj-Djedid Hill and in proximity to the restored cisterns. The sea is not very far distant, and the present trench is contiguous to the land in which Father Delattre discovered so many tombs in 1894.

As M. Gauckler had foreseen would be the case, there were at once found various superposed ruins of structures that corresponded to successive civilizations which have passed over Carthage. In the first place, the débris of the Christian city at the epoch of Theodosius, then, underneath, the remains of the city of the Upper Roman Empire, the epoch at which it attained its greatest splendor, and, in aggrandizing itself, constructed its houses upon the necropolises of Phenician Carthage; and, finally, the débris of the purely Carthaginian civilization of the sixth and seventh centuries before our era, an epoch very curious by reason of the affinities that it presents with Egypt on the one hand and with Assyria on the other.

At the first blows of the pick, the discoveries were important. Under a great mosaic which served as a facing to a structure of the Christian epoch, M. Gauckler came across one of those curious places of concealment in which the last votaries of paganism often endeavored, without always succeeding, to protect their idols against destruction by Christian iconoclasts. It was a walled vault, and was full of various débris that covered a collection of very valuable objects of worship. In the first place, there was a slab of white marble bearing a dedication to Jupiter Ammon signed by twelve priests, having at their head a grand mistress of the rites (Mater Sacrorum); and then, at the bottom of the vault, four white marble statues, three of them well preserved, one representing the Greek Demeter (Ceres Africana), who replaced Tanit, the Phenician goddess, and two others, perhaps representing a Canephore and a Core in the act of walking.

All these statues were of very careful workmanship and were touched up with paint that gave vigor to the marble.

At a depth of about twenty-five feet, M. Gauckler came across the first tombs, the origin of which dates back to the seventh and eighth centuries before our era. They were simple ditches dug in sand at the bottom of a well, or funereal chambers constructed of large bond-stones. Several of them contained terra cotta masks having a grotesque and realistic expression of a striking effect, and were doubtless placed in the tombs in order to frighten such spirits as should trouble the repose of the dead.

DEMETER. CANEPHORE.

FEMALE AND FUNEREAL MASKS.

Nearer to the front of the trench there were discovered some richer tombs that contained silver jewelry, collars of beads of glass or precious stones and a few gold rings.

The richest funereal objects were found in two vaults constructed of very regular flat stones and closed by a flagstone. The interior was covered with a stucco as white as snow, and the ceiling was lined with cypress wood. The skeletons lay directly upon the floor, adorned with their jewels and surrounded with pieces of pottery of all sizes.

In another tomb was found the skeleton of a woman, probably a priestess, holding in its hands a bronze mirror and cymbals of the same metal. It had numerous bracelets of glass beads on the arms and several gold rings on the fingers, and, on the neck, a superb massive gold collar composed of forty elements, and enriched with hard stones.

There was, in addition, a second collar, of silver, a large flagon of enameled earthenware, painted disks of ostrich eggs, a lamp with two burners, and various other objects. This constituted the most complete collection of funereal objects that has been found in a necropolis.

The most curious finds made in other graves consisted of terra cotta molds representing fishes, ibises and masks, but of a different kind from the grotesque masks. These are figures of an entirely Egyptian style as regards head-dress and type of face.

There has also been discovered a jade cylinder of Assyrian origin representing the god Marduk strangling an ostrich.

At present the excavations are being carried on in a region of a very different archæological character from the preceding. They have just brought to light a Byzantine monastery, the most important part of which is already exposed. It comprises a rich basilica with five naves supported by columns of valuable multicolored marbles. The floor is entirely paved with well preserved mosaics.

Along side of the basilica, properly so called, extends a hexagonal baptistry, a chapel with a martyr's tomb, an atrium set apart for ablutions, and vestiaries and different chambers of less certain functions—the whole paved with mosaics of very varied designs.

This monastery was established directly in the center of the ancient Phenician necropolis, and nothing is more curious than to find upon the ground now being excavated the inter-mixture of structures so diverse, which are distributed over a period embracing more than fourteen centuries.

All these discoveries do great honor to M. Gauckler, who has made his researches in a very methodical manner, and it is but just that they have been crowned with success.

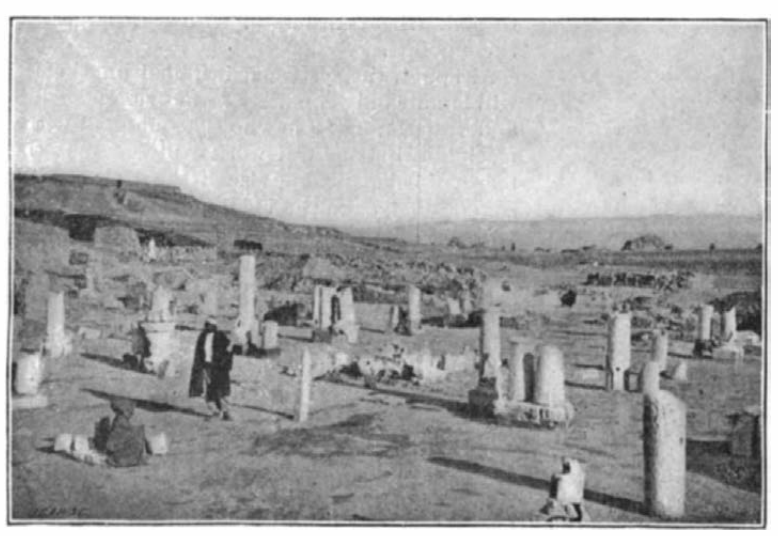
The statues, jewelry, pottery and mosaics derived from these excavations are now on exhibition at the Musée du Bardo.

For the above particulars and the engravings we are indebted to Le Monde Illustré.

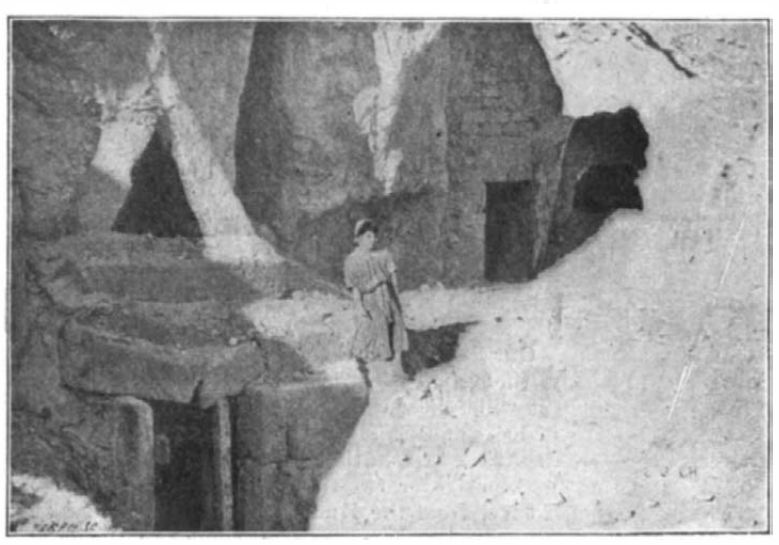
POTTERY.

Protection of California's Big Trees.

Steps are being taken to preserve the famous Calaveras grove of big trees, which will probably pass into the hands of a large lumber firm which has secured an option on this famous grove. It is the intention of the new possessors to build large sawmills in Calaveras County, and they will then turn all of the large trees, which have been made one of the points of interest to visitors, into lumber unless some immediate steps are taken to save them. Various clubs and associations in California are doing their best to save the great trees, which are famous all over the world. It is urged that a national park would be most desirable at this point, as has been done in Mariposa and Tulare Counties.



A BYZANTINE BASILICA UNEARTHED AT CARTHAGE.



PHENICIAN TOMBS.

THE PROPOSED PNEUMATIC BALANCE LOCKS FOR THE ERIE CANAL.

The principles upon which the pneumatic balance lock is constructed are very simple, and may be illustrated by the experiments shown in the accompanying diagrams. If an inverted tumbler be held in a vertical position and pushed downward into a pail of water, the water, as everyone knows, will rise only a small distance within the tumbler, the elasticity of the contained air serving to exclude it. If all downward pressure be removed, and care be taken to maintain the tumbler in a vertical position, it will float. In this condition the air within the tumbler is compressed, and the pressure will depend upon the weight of the tumbler and the area of the surface of the water contained within it. If we take another inverted tumbler, similar in size and weight to the former, and depress it in the water, at the same time tilting it slightly, so that the contained air can escape and the water enter until only an inch or so of air space remains, and if we connect the air-space in the tumblers by a U-pipe, as in Fig. 1, we have exemplified the principles on which the balance lock operates.

If a weight be now placed on the elevated tumbler it will begin to descend, driving the air through the U-pipe into the depressed tumbler and causing it to rise, until the positions are reversed, as in Fig. 2. If the excess weight be transferred to the other tumbler, the air will be forced back through the tube and the tumblers will assume their former relative positions. If, however, we wish to secure the tumblers in the positions, Fig. 2, we can do so by admitting water into the bend of the U-tube, as shown in Fig. 3, for we shall then find that even if we transfer the weight to the elevated tumbler, it will fail to lower it, the water in the tube preventing the flow of the air. If, now, we wish to make sure that the elevated tumbler shall maintain its position at a predetermined height, we can provide a stop above it as shown, and introduce compressed air below it by means of a pipe (see Fig. 3). In this condition the difference of air pressure in the two tumblers will be shown by the difference of elevation of the water in the two legs of the U-pipe, and if there is no leakage of air in the pipes, the tumblers will remain in these relative positions indefinitely, even though the weight be changed from the depressed to the elevated tumblers as in Fig. 4, in which case all that is necessary to reverse the positions is to shut off the compressed air supply, and let the water out of the U-pipe, whereupon the air will begin to flow and the tumblers will assume their new positions.

The simple principles above illustrated have been utilized by Chauncey N. Dutton, a civil engineer of this city, in the operation of a system known as the Pneumatic Balance Locks, which are designed to raise or lower quickly the largest seagoing vessel at a single lift through vertical distances of 100 feet or over. On our front page will be found illustrations of two sets of locks of this type which it is proposed to build on the route of the Erie Canal, one at Lockport, near Lake Erie, and the other at Cohoes, the eastern terminus of the canal. The former locks are to have dimensions to suit the size of canal boat adopted, and an extreme lift of 62½ feet. The Cohoes locks will have the same length, breadth and draught, but the extreme lift will reach the extraordinary height of 144 feet, or many times as much as the extreme lift of the loftiest locks now in existence. Our drawings are made from the plans adopted by the Canal Board and represent this great work as it will appear when completed. The present series of locks of the old type at these two places include the heaviest lifts on the Erie Canal, and together they make up over two-thirds of the total rise of about 572·9 feet from the Hudson River to Lake Erie.

The locks at present in use in the Erie Canal are of the type with which we are all familiar. The vertical distance is overcome in short lifts, and hence many locks are required with a consequent long delay in the passage of boats. Thus at Lockport there are five locks with an average lift of about 11½ feet, and it takes a couple of hours for a tow of five boats (four barges and a steamer) to pass through. At Cohoes, again, sixteen locks with an average lift of about 9 feet are necessary to raise the boats from the Mohawk

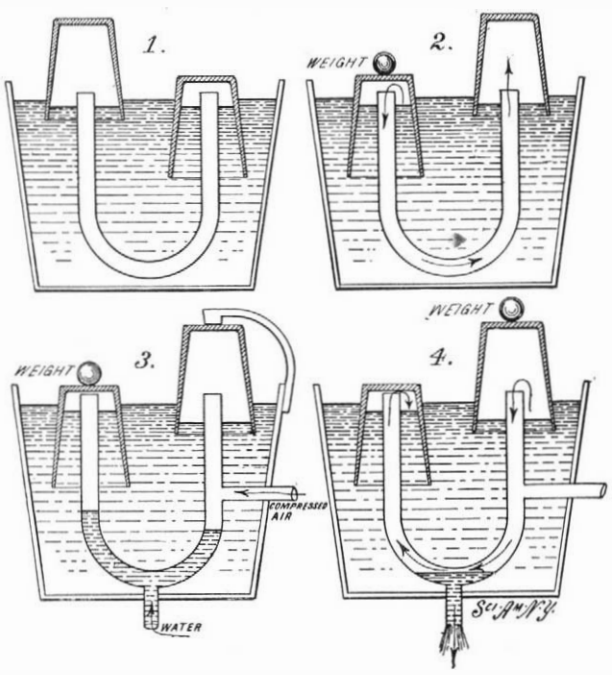
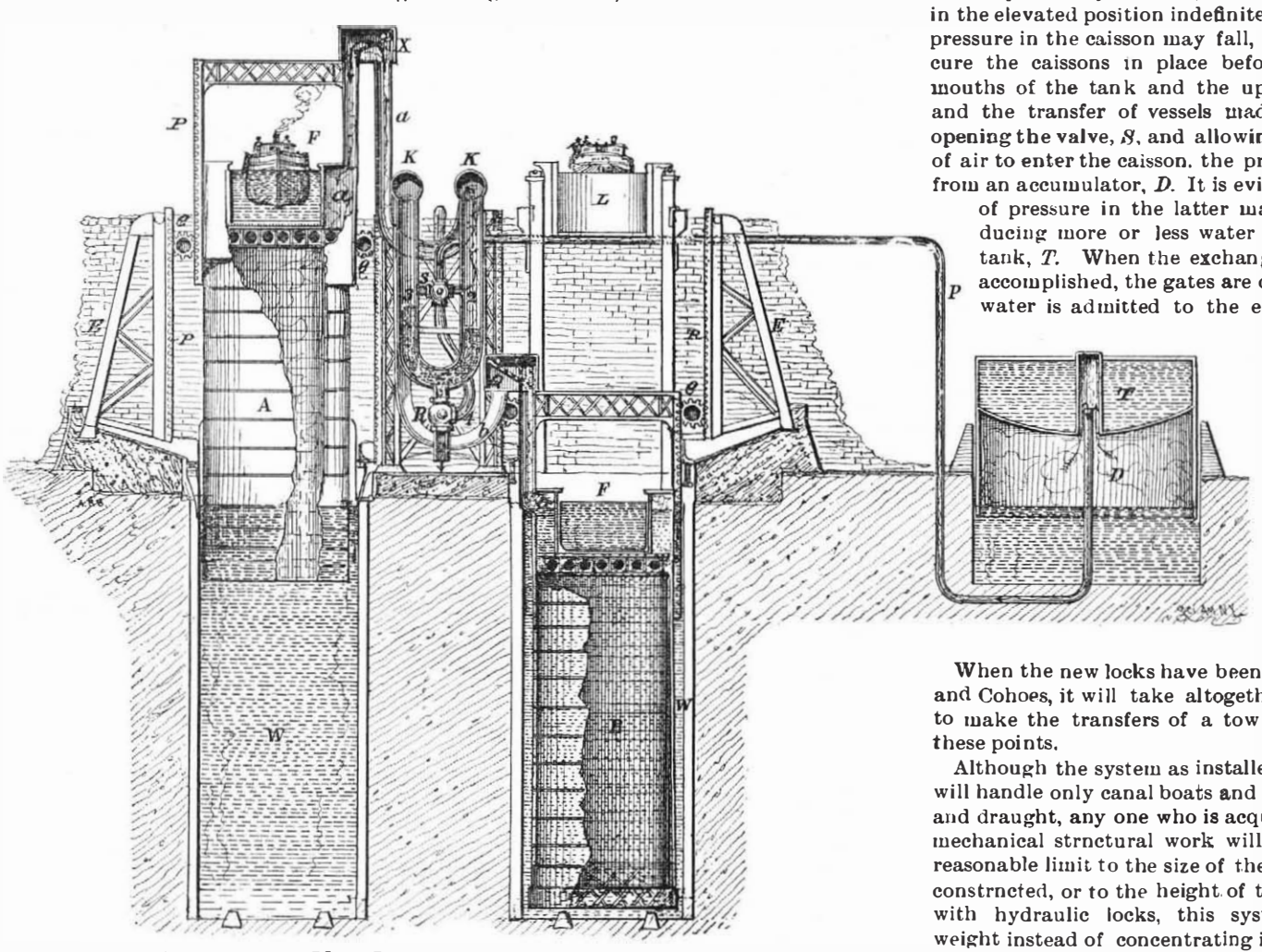


DIAGRAM ILLUSTRATING PRINCIPLES OF OPERATING THE PNEUMATIC LOCKS.

River to the upper level, and here, in busy times, it is estimated that half a day is consumed in the passage of a tow. A pneumatic lock will save in time and towage the equivalent of one-eighth of a cent a bushel in the freight charge an all east-bound grain.

Referring to the drawing of the Cohoes locks on the front page, it will be noticed that the upper level of the canal is carried by a steel aqueduct up to and beyond the edge of the high banks of the river. Here it terminates in two mouths closed by gates, standing vertically 144 feet above the river. Immediately below, and in line with the upper level, are excavated in the bed of the river two great pits, each about 50 feet wide, 320 feet long, and 175 feet deep. In each pit is placed a huge rectangular caisson, whose dimensions are somewhat smaller than those of the pit, so as to allow it to move vertically within the latter. In the cross-sectional drawing given herewith the pits are indicated by the letters *W W*, and the caissons by *A* and *B*. Above the roofs of the caissons are carried tanks, *F F*, which are 32 feet wide, 12 feet deep, and 315 feet long, and whose mouths are closed with watertight gates, similar to the gates, *L*, that close the mouths of the basins at the upper level.



TRANSVERSE SECTION THROUGH COHOES LOCKS.

Now the bottom of the caissons being open and the roof and sides airtight, it follows that when they are immersed in the pits they will float in the same way as the tumblers in the pail of water, and if the air-space in the two caissons be connected by piping, they will balance each other. In the sectional view, the caisson, *A*, is shown raised to its full height of 144 feet; the surface of the water in the tank, *F*, is at the same level as the water in the upper canal, and a barge is shown in the act of entering the tank. The caisson, *B*, is in the lowered position and the mouths of its tank, *F*, are open so that it connects with the Mohawk River, and barges can enter and leave it.

The air-space in the caisson, *A*, is connected by flexible pipes, *a*, *a*, and an emergency valve, *X*, with the right hand leg, 2, of a huge U-pipe, *K*, *K*. 10 feet in diameter, and the air-space in the caisson, *B*, connects through the flexible pipes, *b*, *b*, and emergency valve, *Q*, with the other leg, 3, of the U-pipe. Water is fed to and wasted from the bend of the U-pipe through the pipe, 4, by way of the 3-way valve, *R*, and compressed air is led in from an accumulator, *D*, by the pipe, *P*, by way of the valve, *S*, which introduces the air to leg 2 or leg 3 of the U-pipe, as desired.

The great caissons are maintained in a true vertical and horizontal position by means of massive vertical braced guides, *E*, *E*, and horizontal rolling shafts, *e*, *e*, which extend the full length of the caissons one on each side, and are provided each with four big gear wheels which engage vertical racks, *P*, *P*, on the guides and on the caissons. The rolling shafts are heavy built-up steel tubes, 4 feet in diameter, and of great rigidity, and they serve as a positive parallel motion to keep the caissons absolutely level and prevent any tendency to rocking or binding in the water pits.

The operation is as follows: Let us suppose that the caisson, *B*, is elevated with its tank, *F*, registering its gate with a gate, *L*, of the upper level. If an excess of water be admitted to the tank, *F*, over that contained in the tank of the now depressed caisson, *A*, so that the former will be heavier, the latter will begin to rise and caisson, *B*, to sink, the air passing by way of the pipe, *b*, the U-pipe, *K*, and the pipe, *a*, from caisson, *B*, to caisson, *A*. When *A* has reached the upper level, as shown in the cut, it becomes necessary to lock it in position and prevent the air from flowing back through the pipes. This is done by opening the valve, *R*, and admitting water to the U-pipe, as shown in the sectional drawing. If now there were no change of temperature or of barometer to affect the pressure of the air in caisson, *A*, and no possibility of leaks, the caissons would remain in the elevated position indefinitely; but since the air pressure in the caisson may fall, it is necessary to secure the caissons in place before the gates of the mouths of the tank and the upper level are opened and the transfer of vessels made. This is done by opening the valve, *S*, and allowing an excess pressure of air to enter the caisson, the pressure being derived from an accumulator, *D*. It is evident that the amount of pressure in the latter may be varied by introducing more or less water into the accumulator tank, *T*. When the exchange of boats has been accomplished, the gates are closed, a foot more of water is admitted to the elevated tank than is contained in the lower tank, the water valve, *R*, is opened, allowing the water to drain out of the U-pipe through the waste pipe, *O*, and the air at once begins to flow from the caisson, *A*, to caisson, *B*, the former descending and the latter rising to its new position.

When the new locks have been installed at Lockport and Cohoes, it will take altogether about ten minutes to make the transfers of a tow of barges at each of these points.

Although the system as installed on the Erie Canal will handle only canal boats and vessels of limited size and draught, any one who is acquainted with civil and mechanical structural work will see that there is no reasonable limit to the size of the locks that could be constructed, or to the height of the lift. As compared with hydraulic locks, this system floats the huge weight instead of concentrating it in one point, and it is not handicapped by having to raise the dead weight of a ponderous column of water. The air column within the caisson, however high it may be, does not reduce the efficiency of the system by adding to the weight handled. It would be quite possible, for instance, in the unlikely event of the ship canal being built on the route of the present Erie Canal, to construct pneumatic locks at Cohoes that would lift the 704-foot liner "Oceanic" with as much ease, in spite of her 28,000 tons dead weight, as the Cohoes locks will lift a canal boat.

AN EARLY REAPING-MACHINE.

After having been hidden away for more than half a century in a barn near Spencertown, N. Y., Enoch Ambler's curious old mowing-machine has again seen the light of day at a county fair. Although it was patented as early as December 23, 1834, it was not the first apparatus of its kind; for Obed Hussey, on December 31, 1833, and Cyrus McCormick, on June 21, 1834, as well as others before them, had taken out patents on similar contrivances. And although it appears not to differ materially from the contemporaneous Hussey and McCormick reapers, the old Ambler machine, merely on account of its age, is of sufficient interest to warrant a brief description.

The frame of the machine is supported by a single, central driving-wheel, spiked to prevent its slipping and connected by gearing with a horizontal pulley. By means of a belt passing around the pulley a vertical shaft is driven, which, at its lower end, is provided with a crank to reciprocate a cutter-blade which, it will be observed, is straight and not serrated and is mounted between the upper and lower sections of double fingers carried by a finger-bar. The cutting implements extend seven feet from one side of the machine. As the horses pull the machine forward, the grain, without the assistance of a reel, is received in the spaces between adjacent stationary guards or fingers and is cut by the reciprocating blade. The double fingers which form part of the cutting apparatus were claimed both by Hussey and McCormick as an original invention, and were frequently mentioned in their bitter controversy for the honor of having devised the first successful automatic reaper.

The first trials of the Ambler machine are said to have been in every way successful. But like many another similar primitive contrivance, it possessed the disadvantage of necessitating a very frequent sharpening of the cutter-blade.

Phosphorescent Sulphide of Strontium.

M. José Mourelo has presented to the Académie des Sciences an account of his method of preparing a phosphorescent sulphide of strontium. The same experimenter has previously shown that certain substances, such as carbonate of manganese and sub-nitrate of bismuth, in small proportions, have the property of exciting the phosphorescence of strontium sulphide. In his recent experiments with sulphate of manganese, he has succeeded in obtaining a brilliant phosphorescence. The method of preparation is as follows: A mixture is made of 100 grammes carbonate of strontium, 30 grammes sulphur, and 0·2 gramme sulphate of manganese, pure and anhydrous; these are well mixed and put into an earthen crucible, well closed. The crucible is heated to a bright red for three hours. In this manner a sulphide of strontium is formed which is almost white, hard, and possessed of an intense yellow-green phosphorescence, which may be excited by the exposure of a few seconds to diffused light. The experimenter describes several other methods of preparation, by which he has progressively arrived at results even more satisfactory. He takes, for instance, 100 grammes carbonate of strontium, adding 50 c. c. of water in which has been dissolved 2 grammes of dry sodium carbonate and 0·5 gramme fused chloride of sodium. After desiccation, the mixture is calcined, and to the impure strontia resulting is added 30 grammes of sulphur and 0·2 gramme sulphate of manganese. By submitting this mixture to an intense heat, a sulphide of strontium is obtained whose phosphorescence is more brilliant than in the former case and it is excited with less exposure to light. The experiment which has given the best results is the following: With 100 grammes carbonate of strontium is mixed a solution of 0·2 gramme sulphate of manganese in 50 c. c. water; to the mixture is added 30 grammes of sulphur, 0·5 fused sodium chloride, and 2 grammes sodium carbonate. This mixture, heated in a crucible to bright redness for three hours, gives a sulphide which is rather white, hard, and granular, possessing a very great phosphorescent power, it being excited by the smallest exposure to diffused light.

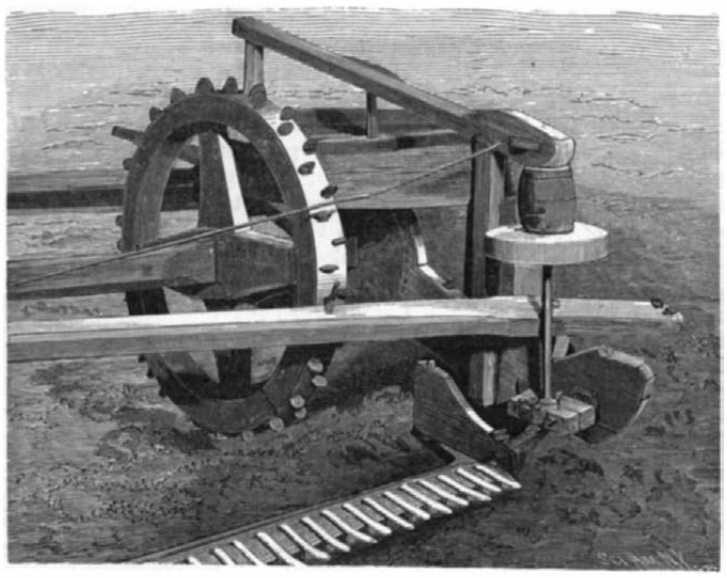
THE Krupp works are to be extended at a cost of not far from a million dollars.

Utilizing New Fish for Food.

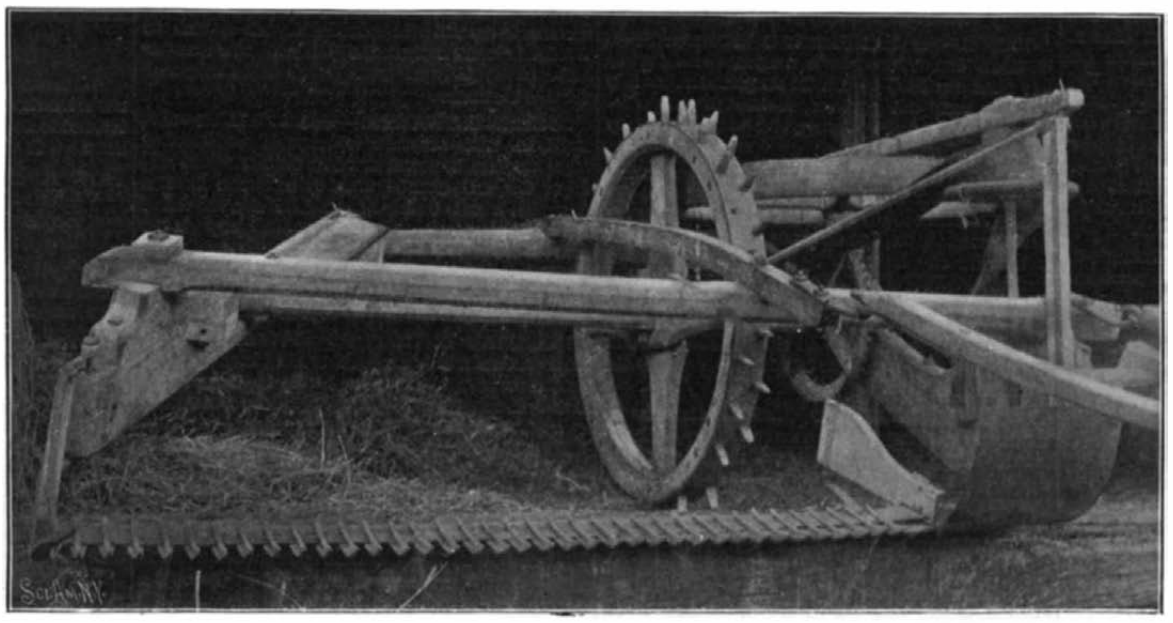
The waste of food products has always been characteristic of our national life, and in the economical preparation of food materials which Americans consider useless, most of the European countries are far ahead of us. But with the rapid growth of our population, and the increasing demand for new varieties of food, the application of scientific principles to the food problem is creating changes for the better. Owing to the progressive activity of an able scientific Fish Commission, American fish culture stands first in the world, and our food fish have been multiplied so enormously by artificial methods of propagation that the supply has always kept well abreast of the demand.

But no individual, or scientific body, is more ready to acknowledge our inferiority to most European countries in the matter of utilizing all fish products than the Fish Commission. It is the abundance of fish food in this country that has prevented Americans from adopting the economical devices found in Europe, and it will be the self-chosen duty of the United States Fish Commission to illustrate the value of the methods of some of the northern countries of Europe in utilizing fish products as food.

In Norway, Scotland, and the Scandinavian countries factories are established for making fish pastes, powders, and extracts that are absolutely unknown in this country. These factories use to a large extent the fish that have little or no commercial value in the markets of the world as fresh or salted food. The nutriment of the fish used is fully as good as the fresh fish, and it is only lack of flavor and palatableness that prevents their general acceptation by our epicures. By converting them into pastes, powders, and fish extracts they obtain for them a position in the food economy of the world that is highly important.



ANOTHER FORM OF THE AMBLER REAPER.



THE AMBLER MOWING-MACHINE OF 1834.

In a forthcoming report the Fish Commission will give elaborate details about the workings of these fish factories in northern Europe, and will even recommend the establishment of similar ones on the Atlantic seaboard. This is especially interesting in view of a recent innovation made by the fish factories of Scotland and Sweden in successfully utilizing the flesh of the shark and whale as fish extract. The concentrated extract of these two gigantic sea inhabitants is put up in sealed cans, and resembles in some particulars the numerous meat extracts put up in this country. The fish extract made from the shark and whale is cheaper than any of our meat extracts, has fully as much nutriment as beef extract, and through chemical treatment all disagreeable fishy flavor is eliminated. For flavoring soups, or for forming the foundation of soups, this fish extract is valuable, and is employed in the countries of Europe quite extensively in general cooking.

Both whale and shark meat is highly nutritious, but the excessive fat of the former makes it unpalatable to any except the inhabitants of the cold northern countries. To overcome this the fat and oil are first extracted in sufficient quantity to make the residue a good foundation for meat extract. The oil that is removed is used for other purposes, while the rich, nutritious liquor and juices are boiled down further and evaporated until they have the consistency of molasses. Then it is flavored in various ways for the market and put up in sealed jars.

The fish meal made in the factories of Norway is another article of food that is practically made from waste or useless material. The flesh of fish that have no recognized standing in the markets in the fresh state is reduced to a fine powder, and by chemical treatment it is prepared so it will keep indefinitely. This fishmeal is highly nutritious, and is eaten extensively by the inhabitants of northern Europe. When properly flavored, it is not an unpleasant article of food. The statement is made by some authorities that this fishmeal contains four times as much nutriment as beef.

Fish paste is another product of these northern factories that has received the universal commendation of culinary experts abroad. The paste is made by reducing the flesh of the fish to a thick mass, with all the natural juices of the fish retained, but with disagreeable strong odors eliminated. This paste is highly seasoned, and is all prepared for making soups and similar delicacies. It is put up in cans and jars, and the French and German cooks depend to quite an extent upon these fish pastes for relieving the monotony of consomme and mock turtle soup at the beginning of each meal.

The question of establishing similar fish factories in this country of course depends upon the supply of available fish that to-day have little economic value. Whales we have not in sufficient abundance to supply the factories with material for their cheap products, but sharks of great variety abound in the waters along our Atlantic seaboard. They could be caught in enormous quantities, and besides supplying the factories with material they would relieve the seas of pirates that undoubtedly tend to keep down the supply of fresh food fish. The porpoises could also help to furnish the factories with raw material, for in the extraction of the oil and fat from these large fish there is a great waste of flesh and fish juices. Our mossbunkers and menhaden, which are now used chiefly for bait for blue and other fish, might find a new use in the fish factories, while dogfish, skates, and similar inhabitants of the deep that are inimical to the fishing industry would inevitably be utilized for paste and extracts.

The swordfish has already become popular as an article of diet, although it was not many years ago that the flesh of this fish was considered unfit to eat. Around Block Island to-day there are numerous swordfish hunters, who depend upon the industry for a living. The fish are sold in New York and Boston at paying prices, and most summer hotels have swordfish steaks on their bill of fare. The swords of the fish are sold as souvenirs. Swordfish steak is cut with the grain, and retails at 12 to 15 cents a pound, and the supply hardly equals the demand, especially in summer. The fish caught off the coast run from two to six hundred pounds in weight. Formerly all of these monsters were allowed to live in the ocean without thought of using them for food, but now both the fishermen and the consumers are benefited by the discovery of their really valuable qualities as fish diet. While it may not be possible ever to popularize the flesh of the blue, leopard, or shovel-nose sharks as fresh fish, the factories of the future will utilize them for making fish paste, fishmeal, or fish extract. G. E. W.

THE Rome correspondent of The London Lancet has made a suggestion that the salt which from the earliest ages has been mingled with the water for ceremonial church purposes should be modified so as to make it a true disinfectant.

Automobile News.

Automobiles have appeared at a number of hunts and shooting meets in England.

The Automobile Velo Club, of Nice, has arranged a week's meeting on the Riviera, and another club is doing the same for Pau.

The French army authorities have been conducting tests with the Scotte steam vehicles for heavy traction work. It does the work which was formerly performed by thirty-two horses. The speed of the Scotte road train is much faster than that of the traction engine, and as no stops are necessary to change horses, a long journey can be expeditiously made.

Mr. James T. Allen, Examiner, United States Patent Office, has been compiling a volume dealing with all patents on carriages propelled by electricity, gas, steam, or other power between 1789 and July 1, 1899. It will contain photographic reproductions of all the drawings, with text dealing with the matter of the essentials, of the specifications, the claims in full, and other matter.

The Italian general staff has ordered the construction of a few automobile caissons for field artillery, which will be made to demonstrate their practicability this spring. The War Office will make public the results of their experiments during the Exposition. Three models for ordinary field service will be shown. First is a strongly built vehicle of high power and of the racing pattern, provided with a motor which will produce a speed of 40 miles an hour. It is intended for the carrying of dispatches. The second will be a heavyweight traction car for carrying large field pieces. There will also be a very light petroleum motor tricycle armed with a Maxim gun. Motor ambulances, wagons for the use of the field telegraph service and motor cars for the use of the staff will also be exhibited.

The Automobile Cab Company, of Boston, will not use motormen as drivers, owing to the fact that the motorman's training bars him from being an efficient driver. On the cars, when any danger threatens, his first thought is to put on the brake with all his might with his right hand. On a cab, however, the right hand deals with the steering lever, which is a wholly different matter, and the driver who had been a motorman would probably forget in emergencies and try to stop the cab by pushing the steering lever just as he used to manipulate the brake handle. This usually results in the cab running wild, and it is liable to do serious injury. An accident which occurred in Boston last summer was traceable to the fact that the man in charge was an ex-motorman, and the old instinct got the better of him.

An automobile with three occupants was run into by a trolley car in New York on June 21. The horseless vehicle was going at a pretty good rate on Fifty-ninth Street just west of Sixth Avenue, when the driver lost control of the steering apparatus. A Sixth Avenue trolley car came around the curve at Fifty-ninth Street also at a high rate of speed. The motorman thought that the automobile would get out of the way; the result was that the two vehicles came together and the light carriage was thrown against the wall of the Park, clear across the stone sidewalk. The three occupants were thrown against the wall and under the wreck of the vehicle. No one was seriously injured. The automobile was completely wrecked. This should be a lesson to all drivers of such vehicles, especially in cities, to take more precaution than they would with horse-drawn vehicles. Accidents of this kind injure the automobile industry, and the drivers cannot be too severely condemned.

In one of its recent meetings, the Automobile Club of France proceeded to choose the equipages which were to represent it in the contest to be held next year for the Gordon Bennett cup. The two equipages chosen were: 1st, Messrs. R. de Knyff, Charron and Girardot; 2d, Count de Chasseloup-Laubat, Hourgières, Lemaitre and Levegh. This choice has been the subject of some discussion on the part of the persons named and others, and it is not certain whether the choice will be final or not. Several of the automobile clubs of Europe have signified their intention to take part in the contest. The Duke of Ratibor, president of the Automobile Club of Germany, has just officially announced to the Paris Club that his club will take part in the contest. The Automobile Club of Belgium has also signified its intention to enter the competition, and has chosen three of its best conductors to contest the cup next spring. On the contrary, the Swiss and the Austrian clubs have announced that they cannot take part in the contest until 1901, as the automobile industry in these countries is not yet sufficiently developed.

The New Tomb of Fulton.

The special committee of the American Society of Mechanical Engineers now has $1,200 toward the new monument, and the amount needed is about $3,000. It is thought that the balance will be raised promptly in the next few months, so that the tomb can be prepared during the summer and the interment and dedication will take place during the annual meeting of the society in December. It will be a plain granite receptacle with probably nothing more than the name of Fulton on the side toward the street, and an inscription on the other side will recite the facts of the erection of the sarcophagus by the society. An illustrated monograph on Fulton is to be issued by the society, and it will be prepared by H. H. Suplee. It will include illustrations of all known memorials of Fulton, the richest collection of which is in the possession of the society. There is reason to believe that the transfer of Fulton's remains will be followed by a movement to erect a costly monument to the inventor.

The Current Supplement.

The current SUPPLEMENT, No. 1257, has many articles of importance. "The Present Status of the Caprifig Experiments in California" is by Dr. L. O. Howard, and it corrects erroneous notions which obtain regarding this curious subject. "The Problem of Honeycomb" is by Charles Dawson, and is an interesting paper. "The Insect Foes of Tobacco" is an elaborately illustrated article. "Recent Improvements in Rice Culture" is by Dr. Eugene Murray-Aaron, and is illustrated. "Animal Electricity" is by W. S. Hedley. "The Progress of Automobilism in 1899" describes the principal advances of the year.

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RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

GRASS OR STUBBLE BURNER.—DANIEL MORRISON, Maple Creek, Northwest Territories, Canada. On the prairies of the United States and Canada the flames from burning stubble and grass often spread and cause no small damage to buildings. The inventor has devised a machine which burns the dried grass, but prevents the spreading of the flames by means of aprons of fire-proof material. The apparatus sets fire to the stubble and forces the flames in the right direction by a draft of air as it moves over the ground, thus burning a strip equal in width to the width of the machine.

HARROW AND PULVERIZER. — HENRY G. MOSHER, Fairmount, Neb. The harrow and pulverizer is constructed with crushing-plates and toothed bars, arranged so that both may be adjusted at the same time, or so that the plates may be adjusted independently of the toothed bars. The grouping of the plates and the toothed bars is such that the plates, when placed parallel with the ground, will insure the teeth's entering the soil the desired depth, thus enabling a field to be evenly harrowed, even when young plants are just sprouting from the ground.

Engineering Improvements.

ROTARY ENGINE.—HORACE FISHERING, Xenia, Ohio. The circular body of the engine has annular grooves in both ends leading to a central partition, with bladeways passing from end to end and through the partition. In these ways chambered blades operate to give passage for steam and to prevent the cushioning and pounding of steam as the blades play automatically in and out of the piston-slot or ways. Rods on the middle section of the ways extend out through the rim and have slides attached to their outer ends engaging a cam or track, the orbit of which is composed of arms, the centers of which are diametrially opposite each other from the piston-shaft. The inner arc permits the blade to be in its innermost position to pass the abutment; the outer arc permits the blade to be in its outermost position covering the steam-space, the length of this arc being the distance between the inlet and exhaust port. An arc on either side unites these two arcs, causing the automatic action of the blade and completing an orbit or track absolutely without an abrupt point.

Railway-Appliances.

INTERCEPTING-VALVE FOR AIR-BRAKES. — GEORGE W. BUCKALEW, Memphis, Tenn. By the use of an intercepting-valve, devised by the inventor, one or more engines coupled to the rear end of the train as helping engines, are enabled to co-operate with the leading engine in supplying air from their main reservoirs, to the train-pipe, so as to assist in supplying the brakes in long trains. When the devices are applied, they are so adjusted on the leading engine as to be thrown out of action, so that the leading engine acts in the usual way to apply the brakes for the whole train by a reduction of pressure in the train-pipe through the engineer's valve of the front engine. But with the rear engine the devices, by proper adjustment, are brought into action for automatically supplying to the train-pipe air from its main reservoir and still permitting pressure to be reduced in applying the brakes from the front engine.

Miscellaneous Inventions.

CORSET.—LAHVESIA PAXTON C. PACKWOOD, Lake Maitland, Fla. The corset is composed of front and rear parts connected by buckled straps and unprovided with the usual side portions. A corset thus made, besides fitting the figure properly, enables the body freely to perform physical exercises.

CONVERTIBLE BEDSTEAD.—ADRIAN DE PINIEC-MALLET, Bensonhurst, Brooklyn, New York city. To convert a bedstead from a double into a single bedstead or vice versa, the inventor employs two bedsteads having interlocking engagement and moving transversely one upon the other to form a bed of the form desired. One bedstead has a transverse connection between its posts on the outside and the other bedstead has a transverse connection between its posts on the inside the posts of one bedstead being movable between the posts of the other bedstead.

COMBINED HOOK AND CLASP. — CHARLES V. RICHARDS, Skowhegan, Me. This device comprises essentially three parts—a body-plate, a clamping-plate and a connecting-link between the two—so combined that they are adapted to be attached to the waist-band of a skirt and to be supported from a belt of that type which is independent of the skirt.

ACETYLENE-GAS GENERATOR.—AUGUSTUS F. SHRIVER, Arbuckle, Cal. The generator comprises the usual gasometer having a rising and falling bell and a generator connected by a pipe with a water supply. A lever operates a valve in the pipe and has a roller upon its free end adapted normally to engage the side of the gasometer-bell, thereby to be held in an inclined position, and also adapted to pass over the upper end of the bell when it falls sufficiently to open the water-supply valve to admit water to the carbid and generate a fresh quantity of gas.

FIRE-ESCAPE.—ALFRED HOLDEN, Manhattan, New York city. The fire-escape comprises a drum upon which a chain or rope ladder is wound. The drum is mounted at the top of a building and is connected with an electric motor, so that it may be turned either to wind or unwind the ladder. The motor is operated by means of a switch which is located on the ground or at any easily-accessible place at a distance from the motor.

NEGATIVE-HOLDER. — FRANK C. MEYER, 1310 Myrtle Avenue, Brooklyn, New York city. The object of this invention is to provide a convenient casing for packing, storing, and preserving photographic negatives. The holder provided for this purpose consists of a series of flexible, parallel leaves having their central portions cut out to allow the circulation of air. Strips are arranged between the base portions of the leaves, both leaves and strips being secured solidly together, so that the strips form a solid base-support for the negatives. The construction prevents contact of the negatives with one another when placed between the leaves, permits circulation of air, thereby preventing molding, excludes dust, and protects the plates during shipment and storage.

FOUNTAIN-PEN FILLING-DEVICE. — LYMAN FISK, Hackensack, N. J. Through the stopper of an ink-bottle a suction-pipe extends carrying a piston at its outer end. The reservoir of the pen is pushed over the outer end of the suction-pipe, forcing out the air through a vent in the stopper. In drawing the reservoir back a vacuum is created, which causes the ink to rush up through the suction-pipe and fill the pen. The reservoir may thus be rapidly and easily filled without danger of staining the fingers.

CURTAIN-SUPPORTER. — MRS. A. T. K. HAWLEY, Delhi, La. This supporter for curtains, portières, and other hangings, by means of which the curtains are held in regular and graceful folds by automatic devices, comprises a tube having a longitudinal slot, one end of the tube being open. A head removably engages the end. A retractile coil spring is fitted in the tube and has one end secured to the removable head. Fastening devices for the curtain are engaged with the coils of the spring and project slidably through the slot in the tube.

FIREMAN'S LIFE-SAVING APPLIANCE.—WILLIAM H. CORNELL, Brooklyn, New York city. The invention provides a means for facilitating the saving of lives by firemen, an end which is attained by constructing an appliance to be strapped to the fireman and capable of being carried to the person to be rescued. The device is so constructed that it can also be used at the end of a line for lowering persons from the windows of a burning building, instead of carrying them down on the back of a fireman.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS ETC.

ON THE THEORY AND PRACTICE OF ART ENAMELING UPON METALS. By Henry Cunyngham, M.A. London: Archibald Constable & Company. New York: The Macmillan Company. 1899. 12mo. Pp. 136. Price $1.60.

Enameling is a most fascinating art, which is not properly understood to-day. So far as we remember, there is no practical treatise at all in English, and for this reason the present work will be warmly welcomed. Owing to the factory-system, art craftsmen find it difficult to earn a living, and the art of enameling bids fair to become a lost art as far as the best work is concerned. The present admirable book will do much to prevent the art from becoming forgotten. Many illustrations are made from actual photographs taken in the workshop.

STANDARD POLYPHASE APPARATUS AND SYSTEMS. By Maurice A. Oudin, M.S. New York: D. Van Nostrand Company. 1899. 12mo. Pp. 249. Price $3.

The development of the polyphase apparatus and the application of the polyphase systems to the solution of engineering problems have been so rapid of late that there is no valuable literature on the subject that is at once practical and up-to-date. This in itself would be a satisfactory reason for the publication of the present work. Many who thought they were thoroughly familiar with electrical matters ten years ago find that they are absolutely at sea when the two-phase, three-phase and monocyclic systems are concerned. The book is an admirable treatise.

THE IRONMONGER'S DIARY FOR 1900. London: The Ironmonger. 1899. Quarto. Pp. 568.

This annual volume is a complete diary for the year, and is interleaved with sheets of blotting paper. There is a certain amount of practical information in the front, and the bulk of advertising matter is impressive.

HOW TO RUN ENGINES AND BOILERS. With a New Section on Engines and Boilers. By Egbert P. Watson. New York: Spon & Chamberlain. 1899. 18mo. Pp. 160. Price $1.

The author, who has contributed many articles on the same subject to the SCIENTIFIC AMERICAN, is amply qualified to deal with the subject, and he has succeeded well within the limits which have been laid down for him.

INTRODUCTION TO PHYSICAL CHEMISTRY. By James Walker, D.Sc., Ph.D. London and New York: The Macmillan Company. 1899. 8vo. Pp. 335. Price $2.50.

The present work answers the majority of the questions which are sure to be asked by the beginner in chemistry. In no other work have we seen the broad facts relating to atomic weights, equations, specific heats, solubility, etc., so clearly described. The average work on chemistry usually begins with a page or two of preliminary matter, and then the elements are taken up in detail. Every teacher of chemistry can read this book with profit.

PHOTOGRAPHIC MOSAICS. By Edward L. Wilson. Thirty-sixth year. New York: E. L. Wilson. 1900. 16mo. Pp. 288. Price $1.

An excellent annual; the literary contents appeal to all photographers. The most modern, up-to-date methods are described.

LEXICON DER METALL-TECHNIK. Redigirt von Dr. Josef Bersch. Parts 16 to 20. Vienna: A. Hartleben. 1899. Price per part, paper, 70 cents.

DIE MODERNE CHEMIE. Eine Schilderung der Chemischen Grossindustrie. Von Dr. Wilhelm Bersch. Parts 16 to 20. Vienna: A. Hartleben. 1899. Price per part, paper, 70 cents.

Monumental Records.—We have received the first two numbers of this interesting periodical, to which we have referred on another occasion. The new series has now been started and the periodical gives promise of being in the front rank of the archæological periodicals of the world. Certainly we do not know of any which is so well illustrated, and the text is excellent. It is edited by Rev. Henry Mason Baum, D.C.L., and is published by the Monumental Records Association, 76 Fifth Avenue, New York city. Those who believe that archæology is a dull and uninteresting science need only examine the issues of this unique periodical to understand their error.

Business and Personal.

The charge for insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in the following week's issue.

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Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

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(7818) E. A. writes: I have an experimental-science book on electricity bought from you and would like to know if you could give me a few explanations about caustic potash batteries, page 408, Fig. 404, illustrated. I would like to know if possible the proportion for making this battery, how much zinc, oxide of copper and potash solution. Is it good for sparking purpose? A. The zinc may be of any size you find convenient. The potash solution is to be saturated, that is, dissolve all the caustic potash in the water which you can, at ordinary temperature. The copper oxide may be put on the bottom of the cell to the depth of an inch or so. Proportions are not important, else they would have been given in the book. You would better buy the Edison-Lalande cell, which is an improved form of this cell. It is widely used for sparking purposes.

(7819) C. L. says: I want to get a preparation of gums or some sticky matertal to use in this manner in tableting sheets of paper, spread thinly on cloth and dried; when wanted, to be wet with water in sponge and applied to the end of tablet, where it will hold every sheet, yet allow them to be torn off and will remain flexible. A. The composition is said to be prepared as follows: Glue, 4 lb.; glycerine, 2 lb.; linseed oil, ½ lb.; sugar, ¼ lb.; aniline dyes, q. s. to color. The glue is softened by soaking it in a little cold water, then dissolved together with the sugar in the glycerine, by aid of heat over a water bath. To this the dyes are added, after which the oil is well stirred in. It is used hot. Another composition of a somewhat similar nature is prepared as follows: Glue, 1 lb.; glycerine, 4 oz.; glucose sirup, about 2 tablespoonfuls; tannin, one-tenth oz. Give the compositions an hour or more in which to dry or set before cutting or handling the pads.

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JANUARY 23, 1900,

AND EACH BEARING THAT DATE.

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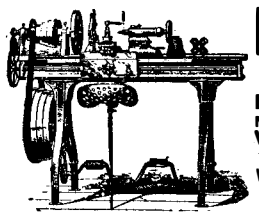

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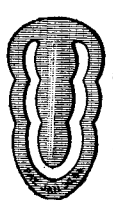

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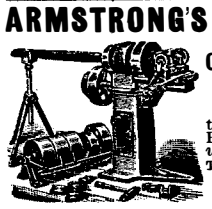

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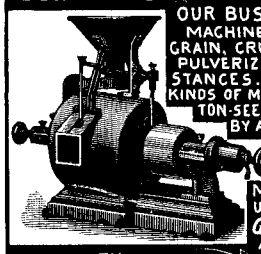

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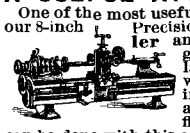

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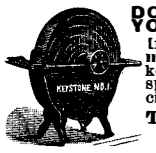

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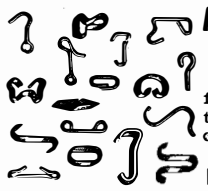

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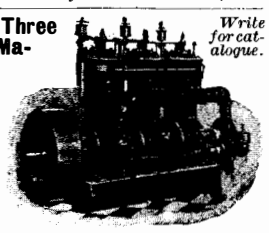

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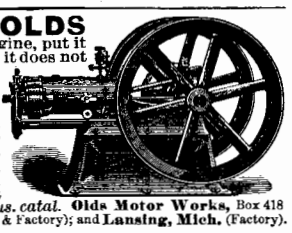

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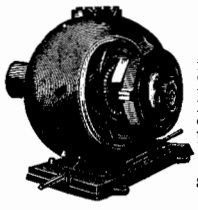

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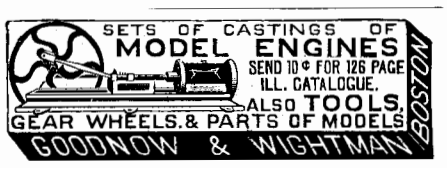

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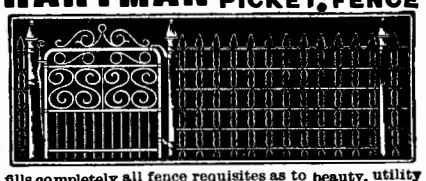

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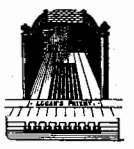

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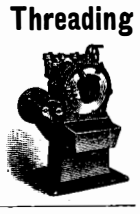

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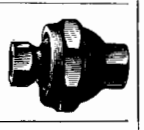

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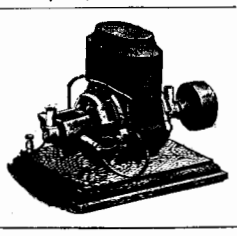

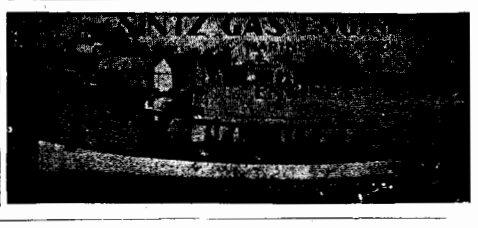

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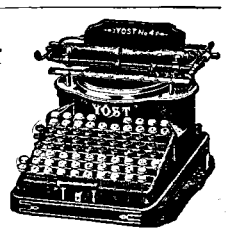

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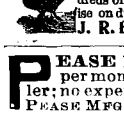

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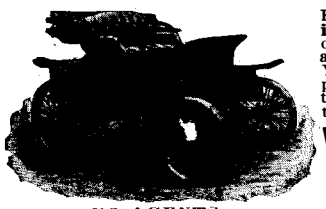

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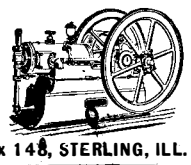

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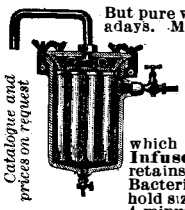

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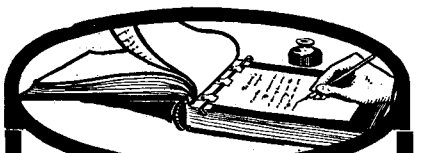

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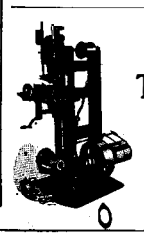

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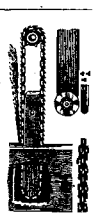

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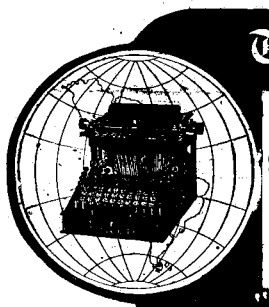

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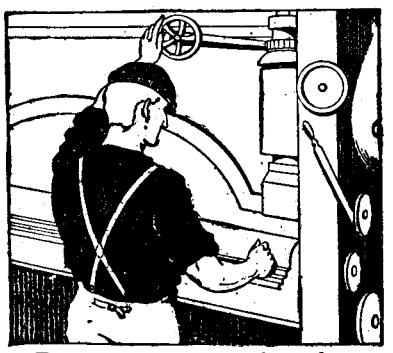

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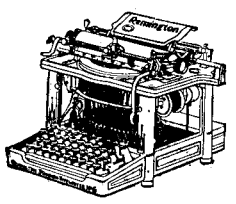

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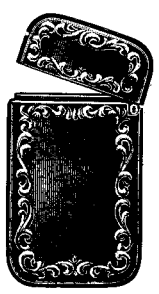

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